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# FINAL
# FEASIBILITY STUDY (FS) REPORT

Barrels, Inc. Site
City of Lansing
Ingham County, Michigan



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## LIST OF ACRONYMS AND SHORT FORMS

| | |
|---|---|
| ARAR | - Applicable or Relevant and Appropriate Requirement |
| CERCLA | - Comprehensive Environmental Response, Compensation and Liability Act |
| CRA | - Conestoga-Rovers & Associates |
| CSXT | - CSX Transportation |
| cy | - Cubic Yard |
| FS | - Feasibility Study |
| MCLs | - Maximum Contaminant Levels |
| MDEQ | - Michigan Department of Enivronmental Quality |
| MTV | - Mobility, Toxicity or Volume |
| NCP | - National Oil and Hazardous Substances Pollution Contingency Plan |
| NPL | - National Priorities List |
| PAHs | - Polycyclic Aromatic Hydrocarbons |
| PCBs | - Polychlorinated Biphenyls |
| POTW | - Publicly Owned Treatment Works |
| PRPs | - Potentially Responsible Parties |
| RAGS | - Risk Assessment Guidance for Superfund |
| RCRA | - Resource Conservation and Recovery Act |
| RI | - Remedial Investigation |
| ROD | - Record of Decision |
| SARA | - Superfund Amendments and Reauthorization Act |
| Site | - Barrels, Inc. Site |
| SOW | - Scope of Work |
| SVOCs | - Semi-Volatile Organic Compounds |
| sy | - Square Yard |
| U.S. EPA | - United States Environmental Protection Agency |
| UST | - Underground Storage Tank |
| VOCs | - Volatile Organic Compounds |

# 1.0 INTRODUCTION

This Feasibility Study (FS) report for the Barrels, Inc. Site has been prepared by Conestoga-Rovers & Associates (CRA) on behalf of the Barrels, Inc. Site Participating PRP Group. This report is submitted to the Michigan Department of Environmental Quality (MDEQ - formerly Michigan Department of Natural Resources) in accordance with the Consent Decree dated March 1, 1993 and the Remedial Investigation/Feasibility Study (RI/FS) Work Plan, dated December 1992.

## 1.1 FEASIBILITY STUDY BASIS AND OBJECTIVES

### 1.1.1 Basis

The Barrels, Inc. Site is the subject of an MDEQ State-lead CERCLA enforcement action. The primary regulation that governs remedial actions at this Site is Part 201 the State of Michigan Natural Resources and Environmental Protection Act, 1995 Public Act (PA) 451 (henceforth denoted as Part 201 of PA 451, or just Part 201), as amended (formerly PA 307). However, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) provides the regulatory frame work to address the requirements of CERCLA and also provides the basis for the evaluation of remedial action alternatives during a Feasibility Study. Therefore, both the NCP and PA 451 will serve as the basis for this FS report.

### 1.1.2 Objectives

The objective of the Feasibility Study presented in this report are as follows:

- to assess the Site conditions defined during the Site RI (dated April 21, 1995);

- to assess the need for and scope of possible remedial measures which may be necessary based on the industrial nature of the Site and surrounding properties; and
- to conduct a Site-specific assessment for the remedial alternatives evaluated in the FS.

The response alternatives will be based on cost-effective reduction of risks to public health, safety, and welfare, and to the environment and natural resources, consistent with Rule 717 of Part 201.

## 1.2 ESTABLISHMENT OF REMEDIAL RESPONSE OBJECTIVES

The purpose of establishing remedial response objectives (or goals) is to provide a benchmark against which to evaluate the selection of remedial response alternatives.

*"Ideally, such goals, if achieved, should both comply with applicable or relevant and appropriate requirements (ARARs) and result in residual risks that fully satisfy the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requirements for the protection of human health and the environment"* (page 1, RAGS, VI, Part B). As identified in RAGS, VI, Part B, the development of remedial response objectives requires the following Site-specific information:

1) media of potential concern;
2) chemicals of potential concern; and
3) probable future land use.

The following presents general and Site-specific remedial objectives for the Site remedial action. General remedial objectives are defined by PA 451 and are applicable to the Site. These objectives relate to the statutory requirements for development of any remedial action. Site-specific objectives relate to specific contaminated media, and potential exposure routes. Site-specific objectives also identify target remediation areas and concentrations. Site-specific objectives require an understanding of the contaminants in their respective media. The Site-specific objectives are developed based on the risk to the public health and the environment, and applicable or relevant and appropriate requirements (ARARs). These objectives should be made as specific as possible without limiting the range of alternatives that can be developed for detailed analysis.

### 1.2.1 General Remedial Objectives

The State of Michigan Natural Resources and Environmental Protection Act, 1995 PA 451, as amended, states that remedial action undertaken shall, at a minimum, accomplish all of the following:

- "Assure the protection of the public health, safety, and welfare, and the environment." (Section 20118 (2)(a))
- "... attain a degree of cleanup and control of hazardous substances that complies with all applicable or relevant and appropriate requirements, rules, criteria, limitations, and standards of state and federal environmental law." (Section 20118 (2)(b))
- "... be consistent with any cleanup criteria incorporated in rules promulgated under this part,". (Section 20118 (2)(c))

### 1.2.2 Site-Specific Remedial Objectives

The following Site-specific remedial objectives have been developed for the Barrels, Inc. Site based on the general remedial objectives, identified contaminants, estimated risks, and migration pathways:

- minimize the potential for direct contact with media which present unacceptable risks to future on-Site industrial workers; and

- manage the affected groundwater below the Site to protect human health and downgradient environmental conditions.

### 1.2.3 Levels of Residual Risk

The Barrels, Inc. Site is an abandoned site located in an industrial/commercial area. All adjacent property land uses are industrial or commercial. For the purposes of the Barrels, Inc. Site, a residual risk level of $10^{-5}$ for an industrial site usage scenario is considered protective of human health. With respect to soils, the residual risk level will be applied directly by utilizing the MDEQ Part 201 Industrial criteria as the cleanup criteria. This is consistent with the approved FS Work Plan which indicates that primary consideration should be given to industrial cleanup alternatives.

With respect to groundwater, it is assumed that due to available municipal water supply and the shallow, unusable, nature of the aquifer, the shallow aquifer will not be utilized as a water supply. As such, the criteria established for groundwater is to meet Part 201 criteria for Site-related constituents at the down gradient boundary (Grand River Avenue).

The effect of soil constituents leaching to the groundwater is not considered in the remainder of this report for the following reasons:

i) there is an expansive clay stratum underlying the majority (greater than 95 percent) of the Site which will effectively prevent downward migration of the majority of compounds;

ii) groundwater contamination consists of few parameters at very low concentrations; and

iii) options evaluated will include limiting contaminant migration and long-term groundwater management, and thus leaching to groundwater is not considered an issue.

## 1.3 REPORT ORGANIZATION

This report is presented in the following sections:

Section 1.0 - Introduction
Section 2.0 - Current Site Conditions
Section 3.0 - Evaluation of ARARs
Section 4.0 - Identification, Description and Prescreening of Remedial Technologies
Section 5.0 - Initial Screening of Remedial Technologies
Section 6.0 - Development and Detailed Evaluation of Remedial Response Alternatives
Section 7.0 - Selected Remedial Alternative

Section 2.0 presents a summary of the current situation at the Site, as developed during the RI which was completed during 1993 and 1994.

Section 3.0 presents Federal, State, and Site-specific ARARs which may be applicable to the Barrels, Inc. Site.

Section 4.0 lists, describes, and pre-screens potential remedial technologies which may be applicable for Site remediation (i.e., for assembling remedial response alternatives).

Section 5.0 provides an initial screening of the remedial technologies remaining from Section 4.0 in terms of their effectiveness, implementability, and cost.

Section 6.0 presents the development of potential remedial response alternatives utilizing the technologies retained from the initial screening conducted in Section 5.0. A detailed evaluation of the remedial action alternatives developed is then completed in terms of the RI/FS Work Plan criteria and MDEQ Requirements, as follows:

1) Assessment of the effectiveness of the alternative in protecting the public health, safety, or welfare of the environment.

2) Refinement and specification of alternatives in detail.

3) Detailed cost estimation, including operation and maintenance costs, distributed over time, of implementing the final remedy.

4) Evaluation in terms of engineering implementation.

5) Evaluation of technical feasibility.

6) Analysis of whether recycling, reuse, waste minimization, waste biodegradation, waste destruction, or other advanced, innovative, or alternative technologies are appropriate.

7) An analysis of any adverse environmental impacts, methods of mitigation, and costs of mitigation.

8) Analysis of the risks remaining after implementation of the remedy.

9) Analysis of the extent to which the alternative attains or exceeds legally applicable or relevant and appropriate federal and state public health and environmental requirements.

Section 7.0 presents the selected remedial alternative, including a discussion of criteria used to make the selection.

## 2.0 CURRENT SITE CONDITIONS

The purpose of this section is to present an overview of the current situation at the Site. This section is organized as follows:



### 2.1 SITE DESCRIPTION

The Barrels, Inc. Site is a 2.3-acre former drum reclamation facility located in an industrial area in the northern section of the City of Lansing, Ingham County, Michigan. The Site location is presented on Figure 2.1. Figure 2.2 presents a Plan of the Site. The Site is bounded to the north and east by CSX Transportation (CSXT) railway line (formerly Chesapeake and Ohio) and to the west and south by existing industrial properties.

Drainage from the Site is primarily eastward into a ditch along the railway track, at the rear of the property. The ditch invert has a depth of about 1 to 3 feet below the surrounding land surface. Figure 2.2 presents the location of the drainage ditch.

#### 2.1.1 Site Background

Figure 2.3 is reproduced from a historical CSXT plan (date unknown) which indicates that the southern portion of the Site was used as a coal yard by the Cahill Coal Company. The western portion of the Site, along with the other properties along Larch Street, was used by Cutler Oil

Company/Gulf Refining Company, presumably for the storage and distribution of petroleum products.

Barrels, Inc. began operations on the Site around 1961 and continued until 1980, when the Site was abandoned. The Barrels, Inc. reclamation process consisted of: cleaning drums in a caustic solution, rinsing, repairing, and repainting. Spills to surface soils allegedly occurred at the loading dock and drum storage areas. The spills at the loading dock allegedly consisted of the contents of the caustic tank which contained the cleaning solution and residual materials which allegedly remained in most of the drums. Any releases which occurred in the drum storage area would have consisted of residual materials which may have spilled during drum movement, or overflowed when drums occasionally became filled with rainwater.

A total of five groundwater monitoring wells were installed in and around the Site in 1982. Three of the monitoring wells (MW1, MW2, and MW3) were installed by the U.S. EPA on properties adjacent to the Site. The remaining two wells (EDI-4 and EDI-5) were installed on the CSXT portion of the property by CSXT. Wells EDI-4 and EDI-5 have been renamed as MW4 and MW5, respectively. Logs for the Pre-RI wells are presented in the RI.

In 1986, a drum removal action and surface soil sampling program were conducted by the MDNR. Following the soil sampling, the surface soils in the drum storage area were removed to a depth of approximately 6 inches. Nine underground petroleum storage tanks were also removed by the MDNR from the Barrels, Inc. property in 1986. Eight of the tanks were removed from an area east of the existing wooden shed, and one tank was removed from the west side of the Site, near the entrance to the facility.

Subsequent surface soil sampling was conducted by the MDNR in 1987. The analytical results from the 1987 sampling indicate that the surface soils contained variable concentrations of base neutral extractable organics [or semi-volatile organic compounds (SVOCs)], pesticides, PCBs, and inorganics. The data tables as presented in the MDNR's Work Plan, dated March 1992, are provided in the RI. Similar compounds were reported in samples obtained from surface scrapings of the floor slab in the main building.

### 2.1.2 Adjacent Land Use

The Barrels Site is located in an industrial/commercial area, as indicated on Figure 2.2. All adjacent property land uses are industrial or commercial. As a result, environmental conditions at the Site are affected by off-Site adjacent upgradient land uses. Adjacent land uses which may affect the Site include: possible underground storage tank(s) located on the Chocola Cleaning Materials property, Motor Wheel manufacturing plant, Kent Electronics, and two landfills located north of the Site which have been designated Superfund sites. All properties between Grand River Avenue and the Barrels Site are industrial.

South of Grand River Avenue, in the direction of groundwater flow, there are additional commercial properties adjacent to Grand River Avenue, with occasional residential properties further south. The Ingham County Department of Environmental Health has indicated that there are no private wells located in the area, and that all water supply is from deep set municipal wells. This indicates that the shallow aquifer at the Barrels Site would not affect downgradient water users.

Figure 2.2 also presents the locations of former USTs, based on information obtained from the MDNR and the local fire marshal.

It is noted that this area is served with a municipal water supply and municipal storm/sanitary sewers. Review of City sewer plans indicates that combined storm/sanitary sewers are located below Larch Street and Grand River Avenue.

### 2.1.3 Buildings

A schematic of the main building is presented on Figure 2.4. The building is rectangular and has an office area in the front, a loading and unloading dock in the center and a drum restoration area at the rear. The building has a total floor area of approximately 5,200 square feet.

The Barrels, Inc. drum cleaning process included a caustic (wash) tank and flush tank, a 2,000-gallon free standing tank, an open box tank, a 1,500-gallon UST for spillage collection, and two 500-gallon tanks/sumps. The sumps are connected to a drain pipe which discharges to the sanitary sewer. The free standing tank is reported to have been used as a flocculation tank. The purpose of the open box tank is unknown.

A "wood shed" is located to the south of the main building and consists of a dilapidated office and garage structure. Remnant electrical switches and piping were observed within and along the side of this structure.

### 2.1.4 Drum Storage Area

During the operation of the Barrels, Inc. Site, drums destined for recycling were stored on the east side of the Site. During 1986 the MDNR removed all remaining drums from the Site and excavated the top 6 inches of soil. The soils were then disposed off Site. Surface soil samples obtained in the area in 1987 by the MDNR indicate that some soil contamination remained. Reported compounds included SVOCs, pesticides, PCBs, and inorganics.

The parameter groups which were identified by the MDNR: SVOCs, pesticides, PCBs, and inorganics, are parameters that tend to attenuate on soil particles and are not particularly mobile in groundwater. This suggested that the contamination in the drum storage area would be a shallow surface soil problem.

### 2.1.5 Caustic Tank (Loading Dock/Process Tank) Area

Spills from the caustic tank located in the rear of the main building occasionally overflowed the loading dock and allegedly spilled onto the soils at the rear of the building. The spills allegedly consisted of the caustic wash liquid, but may have also contained residual materials from the drums. A tile field is reported to be located at the rear of the building to collect infiltrating spilled liquids. Fluids collected by the tile field drained into a 1,500-gallon UST located at the southeast corner of the building. This UST is referred to as the caustic overflow UST.

### 2.1.6 Underground Storage Tank Area

In 1986, nine underground storage tanks (USTs) were removed from the Site by the MDNR as described in Section 2.1.1. Eight of the USTs were located to the east of the "wood shed", as presented on Figure 2.2. The ninth UST was located on the west side of the main building. The locations of the USTs located on the Barrels, Inc. property presented on Figure 2.2 are based on MDNR field notes for the tank removals. The location of four additional suspected USTs on the Chocola Cleaning materials property are based on information obtained from the local fire marshal.

### 2.1.7 Drainage Ditch

The property drains eastward into a drainage ditch along the CSXT railway line. Soils eroded by Site drainage could settle as sediment into the drainage ditch. The location, and flow direction, of the drainage ditch are presented on Figure 2.2.

## 2.2 REMEDIAL INVESTIGATION SUMMARY

The RI was conducted in two phases in 1993 and 1994. The major field activities conducted during each phase are summarized as follows:

| *Phase* | *Activities* |
| --- | --- |
| Phase I | • Site reconnaissance and surveying<br>• soil sampling<br>• borehole and monitoring well installation<br>• groundwater sampling |
| Phase II | • Site surveying<br>• soil sampling<br>• borehole and monitoring well installation<br>• groundwater sampling<br>• surficial soil sampling |

Drawings 1, 2, 3, 4, and 5 summarize the detections of VOCs, SVOCs, pesticides/PCBs, and inorganics, respectively, reported during the RI. Figures 2.5, 2.6, 2.7, 2.8, and 2.9 represent the corresponding lateral extent and depths of affected soils and groundwater based on MDEQ Part 201 Industrial criteria.

The nature and extent of affected media at the Barrels, Inc. Site were adequately defined in the RI. The following presents an RI data summary for each of the affected areas identified in Section 2.1.

### 2.2.1 Soils

This section presents the extent of soils affected by constituents which exceed the MDEQ Industrial criteria.

Extent of VOCs in Soils

No VOCs were measured at concentrations above the Part 201 Industrial criteria, as presented on Figure 2.5 and Drawing 1.

Extent of SVOCs in Soils

Benzo(a)pyrene was reported at DD-3 above Part 201 Industrial criteria in the 0 to 2-foot sample, as shown on Figure 2.6 and Drawing 2.

Extent of Pesticides/PCBs in Soils

The PCB, Aroclor 1254, was reported above the Part 201 Industrial criteria in four of the 0 to 2-foot samples collected near the east side of the Barrels building, and in the drainage ditch, as shown on Drawing 3 and Figure 2.7. These samples were encountered at boreholes CT-1, CT-3, DD-2 and DD-3. A relatively high concentration of PCBs was reported within the 0 to 2-foot sample at borehole DD-2, at a concentration of 53,000 mg/kg. This location will be referred to as the PCB hot spot in the remainder of the report.

Extent of Inorganics in Soils

DS-1, DS-7, DS-9, DS-14, DS-16, and DD-2 have concentrations of lead in the 0 to 2-foot sample that exceed Part 201 Industrial criteria, as shown on Drawing 4 and Figure 2.8.

### 2.2.2 Groundwater

This section presents the extent of groundwater affected by Site-related constituents which exceed the MDEQ Industrial criteria.

Extent of VOCs in Groundwater

Groundwater contains chlorinated and nonchlorinated VOCs above Part 201 Industrial criteria. Benzene, 1,2-dichloroethane, 1,1,2-trichloroethane, and vinyl chloride were detected in the groundwater above Part 201 Industrial criteria, as shown on Drawing 5 and Figure 2.9.

Chlorinated VOCs are widely present in groundwater under the Site. However, all of the parameters present under and downgradient from the Site are also present in at least one background sample. The only VOC not defined to a Part 201 Industrial criteria in the downgradient direction is 1,2-dichloroethane in MW14-47. This parameter is the single most frequently detected parameter in groundwater but it has never been detected in a soil sample on Site. The only potential parent compound for 1,2-dichloroethane that was reported in the soil was 0.051 mg/kg 1,1,1-TCA from 6 to 8 feet in DS-11. However, the sample containing 1,1,1-TCA at DS-11 is underlain by greater than 2 feet of a natural clay barrier. Another sample collected at 8 to 10 feet in the same borehole (DS-11) did not contain 1,1,1-TCA, suggesting that the compound has not penetrated the clay. No other soil samples anywhere on the Site had 1,1,1-TCA present. The 1,2-dichloroethane in groundwater is therefore concluded to be part of a larger, regional groundwater condition that is flowing under the Barrels, Inc. Site.

A chlorinated parameter which has been reported in the groundwater, and has a potential on-Site soil source is vinyl chloride. The extent of this parameter in groundwater shown on Figure 2.9 suggests that compounds associated with the Site have not migrated off Site. It is considered that natural attenuation is preventing the migration off Site of this compound at levels above the applicable criteria.

The only nonchlorinated VOC reported in the groundwater is benzene at MW2 and MW11. This compound is detected at relatively low concentrations at a location a significant distance upgradient of the proposed Site boundary at Grand River Avenue. Due to the affects of natural attenuation and the long travel distance, it is considered that this compound will not migrate off Site.

Extent of SVOCs in Groundwater

SVOCs were not detected in the groundwater, as shown on Figure 2.9 and Drawing 5.

Extent of Pesticides/PCBs in Groundwater

Pesticides and PCBs were not reported in groundwater, as presented on Drawing 5 and Figure 2.9.

Extent of Inorganics in Groundwater

Lead was reported within MW5-50 and MW6-32 at concentrations above the Part 201 Industrial Cleanup criteria in the initial Phase I sampling. These concentrations were not repeated in subsequent sampling. Other metals were reported, but were the result of the well construction materials.

### 2.2.3 Hydrogeology

The Lansing area is part of a Category III B aquifer, which is described in the Hydrogeologic Atlas of Michigan as an area where the overburden soils consist of interbedded aquifers, aquicludes, and aquitards at depth, but where there may not be an aquifer near the land surface.

During the RI, five cross-sections of the Site were prepared based on the subsurface soils conditions encountered in the borings completed on Site. The cross-section locations are presented on Figure 2.10 and the cross-sections are presented on Figures 2.11 to 2.15.

The cross-sections indicated the following:

1) fill materials are encountered throughout the Site;
2) a confining clay layer underlies the fill materials across a majority of the Site, having a thickness of 4 to greater than 10 feet;
3) the clay stratum is underlain by an interbedded sand/clay and sand/silt sequence, followed by a sand aquifer;
4) the sand aquifer was underlain by a dense clay till of about 7 to 10 feet thick; and
5) the overburden was underlain by bedrock at a depth of about 60 feet.

A discontinuous perched water zone at a depth of approximately 20 feet below grade was discovered during the RI at MW11 and MW13.

The groundwater flow rate is approximately 1.0 feet/day in an approximate south to southwest direction.

### 2.2.4 Barrels Building

Waste Residual samples were collected from the main building and analyzed. The waste residual sludge/liquid was submitted for RCRA hazardous waste analysis, including reactivity, corrosivity and ignitability and TCLP for volatiles, semi-volatiles, pesticides, herbicides, metals, and PCBs. Sample BTH-003 taken from the open box tank (10 feet x 12 feet x 8 feet) exceeded regulatory limits for corrosivity (1.0 SU), chromium (25.0 mg/L), lead (16.0 mg/L), and mercury (0.81 mg/L). Sample BTH-004 taken from the open tank (3 feet x 4 feet x 2.5 feet) exceeded regulatory limits for cadmium (3.9 mg/L). All other samples had no detection or were under regulatory criteria for all parameters and tests.

The residual waste materials consisted of sludges and liquids which remained at the base of the tanks sampled. These wastes had very small volumes, having thicknesses of less than 1 or 2 inches at the base of the tanks.

## 2.3 AFFECTED SOIL ESTIMATED QUANTITIES

During the RI, soil sampling was performed in the areas of the Site which contained potentially affected soil. These areas include the Drum Storage Area, the Caustic Tank Area, the UST Area, and the Drainage Ditch. The data obtained from these samples was used to determine the extent of soils exceeding Part 201 Industrial criteria at the Barrels, Inc. Site. The extent of soils exceeding Part 201 industrial criteria are presented on Figures 2.5 to 2.8.

Using a Generic Industrial remedy approach and based on the data collected during the RI, the volume of affected soil is estimated to be approximately 940 cy, which includes 660 cy of soil affected with PCBs and the remaining 280 cy containing SVOC and inorganic parameters.

## 2.4 WASTE RESIDUALS

During the RI, waste residual samples were collected from the main building and analyzed for RCRA hazardous waste characteristics analysis.

Two samples exceeded regulatory criteria for various parameters and tests. The volume of affected waste residuals is estimated to be approximately 1 cubic yard. It is recommended that the tanks containing waste residuals be cleaned. This action is included in every alternative included in this Feasibility Study, with the exception of the No Action Alternative.

## 2.5 SUMMARY AND CONCLUSIONS

### 2.5.1 Nature and Extent of Chemical Source

This section presents a summary of the major findings and conclusions, based upon the data developed for and presented in the RI.

The RI identified various concentrations of VOCs, SVOCs, PCBs, and inorganics exceeding Part 201 Industrial Criteria to a limited extent in soils. In addition, concentrations of the potential Site-related VOCs; benzene and vinyl chloride were found to exceed Part 201 Industrial criteria in groundwater.

The drawings generally indicate that the compounds detected in the boreholes are few in number and irregularly distributed. The soil boring data also indicate that there is a substantial clay layer across the majority of the Site. The majority of compounds affecting soils were confined to the upper fill soil materials by the clay confining layer.

Groundwater under the Site has been affected to a limited extent by the potential Site-related constituents of benzene and vinyl chloride, but it is also affected by undefined regional sources of groundwater contamination. In particular, 1,2-DCA was found to be an upgradient concern and thus is not addressed in this FS. Benzene and vinyl chloride have not migrated off Site.

#### 2.5.1.1 Background Sources

Based on a review of the Site history and the data generated during the RI, several sources of contaminants can be attributed to off-Site conditions, or operations conducted at the Site prior to Barrels, Inc. Conditions encountered are considered to be typical for areas which have similar historical industrial uses and neighbors, such as were encountered at the Site.

Soils

Past uses of the Site have contributed to the conditions encountered during the RI.

Coal present at the Site has contributed to elevated concentrations of PAHs and inorganics in the shallow soils. Coal was also encountered in samples collected from boreholes BG-1 and BG-2 which were installed in an area north of the Site which was considered to be unaffected by the Barrels operation. Coal was also reported in surface soil samples collected south of the Site from boreholes and monitoring wells. The prevalence of coal throughout the area suggests that it is an area wide historical occurrence and not the result of Barrels, Inc. operations.

Groundwater

Contributions of parameters of concern to groundwater from background or pre-Barrels sources were established during the completion of the RI.

The former USTs at the Site have contributed both a potential source of contaminants and a migration pathway for contaminants through the clay confining layer. As presented in the RI, the excavations to install and remove USTs on the Barrels, Inc. Site and adjacent Chocola property penetrated the clay confining layer creating possible conduits for compounds from the USTs or spilled at the surface. One such UST related compound is benzene.

Several chlorinated organic compounds were also encountered at upgradient/background locations. In particular, 1,2-dichloroethane was reported extensively throughout the Site. This compound was reported within monitoring wells installed both upgradient and downgradient of the Site, including the most downgradient well cluster MW14.

The concentration of 1,2-dichloroethane reported at MW14 is very low at 0.006 mg/L, suggesting that the single parameter plume does not extend a significant distance to the south. 1,2-Dichloroethane was reported in at least one monitoring event in 12 of the 27 monitoring wells installed to investigate the Site. The distribution of 1,2-dichloroethane is irregular in both time and space. It is reported in only one monitoring event in five monitoring wells where multiple (two or three) monitoring events have occurred. It is present in some locations including upgradient and cross gradient locations but absent from some mid-Site locations. In addition, it is not reported in any of the soil samples that have been analyzed. Only one soil sample reported a potential parent material from which the 1,2-dichloroethane could have been derived (0.051 mg/kg, 1,1,1-TCA from 6 to 8 feet, DS-11).

The irregular but widespread occurrence of low concentrations of 1,2-dichloroethane in the aquifer combined with the absence of a measured source in the soil of 1,2-dichloroethane on Site leads to the conclusion that 1,2-dichloroethane in the groundwater is a regional condition.

Vinyl chloride is also a parameter of concern for the groundwater and is present in low concentrations within the Site boundaries. There is no evidence that the vinyl chloride is migrating off Site, as presented on Figure 2.9 and Drawing 5.

### 2.5.2 Fate and Transport

A detailed discussion of the fate and transport mechanisms applicable to the compounds encountered at the Site were presented in Appendix K of the RI. The following summarizes the general fate and transport mechanisms which are applicable.

### 2.5.2.1 VOCs

There are two types of VOC contamination reported at the Barrels, Inc. Site: chlorinated and non-chlorinated.

The chlorinated VOCs, in general, have high vapor pressure and Henry's law constant, making these VOCs very volatile. These compounds also have low sorption ability, allowing them to be relatively mobile in the subsurface. Significant biodegradation of these chlorinated VOCs is not expected.

The nonchlorinated VOCs are BTEX compounds which are subject to environmental fate processes including volatilization, sorption, and biodegradation.

The VOCs reported in the Site soils had relatively low concentrations and were of limited extent. They are not expected to be significantly mobile.

The VOCs reported in the groundwater included benzene and vinyl chloride. The benzene was reported near the former USTs, while the vinyl chloride was reported on the eastern side of the Site. The low concentrations of each compound and their sorption ability will limit their mobility, and has limited their occurrence to below the Site.

### 2.5.2.2 SVOCs

The SVOCs of concern are generally PAHs. PAHs released to the environment are subject to a number of environmental fate processes including sorption, biodegradation, bioaccumulation and, to a lesser extent, volatilization. PAH compounds tend to be removed from the water column by volatilization to the atmosphere, adsorption to particulates or sediments, or by being accumulated by or sorbed into aquatic organisms.

PAHs were encountered at the Site mainly in the form of coal products. The coal PAHs would have high sorption ability and thus would not be expected to be mobile.

#### 2.5.2.3 Pesticides/PCBs

The pesticides/PCBs of concern are chlordane and Aroclor 1254. Chlordane will persist in soil and is described as immobile or slightly mobile. Volatilization from water is considered a significant removal process. However, to a greater extent, the removal process of chlordane from water is adsorption to sediment.

Aroclor 1254, and PCBs in general, strongly adsorb to organic rich sediment and soil. Volatilization and biodegradation are also important fate processes, but may occur only at relatively slow rates.

The chlordane encountered at the Site, though widely dispersed, was reported at low concentrations. It is not expected to be mobile to a significant extent.

The PCBs encountered are generally considered to be sorbed to soils along the drainage ditch and caustic tank area. The only applicable transport mechanism would be erosion of soil particles which is limited to the Site by the drainage ditch.

#### 2.5.2.4 Inorganics

In general, the inorganics of concern can be found in different forms depending on such conditions as pH. Lead is described as immobile, while arsenic is described as relatively mobile.

Lead was encountered near the ground surface soils at several locations. The main method of transport for this metal is considered to be erosion of soils which would limit its mobility to the Site.

Arsenic was found to be widespread at the Site, but generally at very low concentrations. The few elevated soil concentrations encountered are not anticipated to be significantly mobile.

### 2.5.3 RI Conclusions

The following conclusions were made based on the data presented in the RI report.

1) The nature and extent of contamination in the Drum Storage area, the Caustic Tank (loading dock) area, and UST locations had been adequately defined.

2) The nature and extent of contamination within the building had been adequately defined.

3) The effects of Site drainage on the Drainage Ditch had been adequately defined.

4) The hydrogeologic conditions at the Site had been adequately defined.

5) Groundwater quality at the Site had been adequately defined.

Based on the results of the RI, it was recommended that a Feasibility Study be completed as described in the MDEQ approved RI/FS Work Plan.

## 3.0 DETERMINATION OF ARARs

### 3.1 GENERAL

The Superfund Amendments and Reauthorization Act of 1986 (SARA) requires that remedial actions at CERCLA sites comply with Applicable or Relevant and Appropriate Requirements (ARARs) from Federal laws and any more stringent, promulgated State laws. Guidance for the determination of ARARs is presented in the U.S. EPA guidance document entitled "Interim Guidance on Compliance with Applicable or Relevant and Appropriate Requirements", August 27, 1987 (OSWER Directive Number: 9234.0-05). The NCP provides the framework for addressing the requirements of CERCLA.

Applicable or relevant and appropriate requirements (ARARs) are used to develop remedial action objectives and to scope and formulate remedial action technologies and alternatives. ARARs are cleanup standards, control standards, or other substantive environmental limitations promulgated under federal or state law. The consideration of ARARs is made in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, (CERCLA) §121, U.S.C. §9621. CERCLA only requires the consideration of substantive requirements for on-Site remedies.

CERCLA/SARA requires that ARARs be identified during the RI/FS to aid in the preparation of a list of remedial alternatives, the evaluation of remedial alternatives under an FS, and ultimately, the selection of a remedy.

SARA defines ARARs as follows:

Applicable Requirements

Applicable requirements are federal and state requirements such as cleanup standards, standards of control, and other environmental protection criteria or limitations that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site.

Relevant and Appropriate Requirements

Relevant and appropriate requirements are those federal and state requirements that, while not applicable as defined above to the circumstances at a site, address problems or situations sufficiently similar to those encountered at a site that their use is well suited. The regulations provide specific criteria for determining whether a requirement is relevant and appropriate.

During the feasibility study process and in the development of remedial alternatives, relevant and appropriate requirements are accorded the same weight and consideration as applicable requirements.

Other Requirements To Be Considered

This category contains other requirements and non-promulgated documents to be considered in the CERCLA process of developing and screening remedial alternatives. The To Be Considered (TBC) category includes federal and state non-regulatory requirements, such as guidance documents, advisories, or criteria. Non-promulgated advisories or guidance documents do not have the status of ARARs. However, if no ARARs for a contaminant or situation exist, guidance or advisories would be identified and used to ensure that a remedy is protective.

ARARs are categorized by the U.S. EPA as follows:

1) chemical-specific requirements that define acceptable exposure limits and can, therefore, be used in establishing preliminary remediation goals;

2) action-specific requirements which may establish controls or restrictions for specific treatment and disposal activities; and

3) location-specific requirements that may restrict activities within specific locations such as floodplains or wetlands.

Each of these ARAR categories is further discussed below.

1) Ambient or chemical specific:

These requirements consider specific concentration limits of hazardous constituents detected in the various environmental media. For this group of requirements the more stringent ARARs would be considered for determination of an acceptable cleanup level of the specific hazardous constituent. Examples of ARARs which fall under this category include: Maximum Contaminant Levels (MCLs) and Primary Drinking Water Standards.

2) Performance, design, or other action specific:

This group of requirements considers ARARs which are action specific for the management of hazardous substances such as: Resource Conservation and Recovery Act (RCRA) regulations for facility closures; RCRA incineration standards; Clean Water Act pretreatment standards for discharges to Publicly Owned Treatment Works (POTWs). In most cases, these ARARs are considered at the time of the remedial alternative evaluation during the FS.

3) Location specific:

These requirements are generally considered at the time of the final remediation where restrictions on the site characteristics or the surrounding environment exist. Examples include: federal and state siting laws for hazardous waste facilities and sites on the National Register of Historical Places.

The application of ARARs will occur at various stages throughout the RI/FS and at the time of final site remediation. These stages include:

i) during the site characterization phase (i.e., public health evaluation);
ii) during the development of remedial action alternatives;
iii) during the detailed analysis of the remedial alternatives; and
iv) when the final remedial alternative is selected.

The consideration of ARARs is required through each of these stages to ensure that the final site remediation meets all applicable and relevant federal and state requirements.

## 3.2 SITE-SPECIFIC ARARs

On the basis of existing information, including the Consent Decree, the present regulatory environment and the RI activities completed, Table 3.1 presents a listing of potential ARARs that may be of relevance to the Barrels, Inc. Site.

### 3.2.1 RCRA

The Resource Conservation and Recovery Act (RCRA) was promulgated in 1976. RCRA establishes the conditions under which a material is considered hazardous and regulates the disposal of these materials. RCRA is not applicable to wastes disposed of prior to its effective date unless the waste material is removed from the site. Listed hazardous wastes under RCRA may be subject to the requirements of RCRA land disposal restrictions (LDRs). Should RCRA and RCRA LDRs be considered applicable to the Barrels, Inc. waste materials, a waiver of RCRA requirements could be granted by U.S. EPA, if necessary.

### 3.2.2 TSCA

The Toxic Substances Control Act (TSCA) was promulgated in 1978 to regulate the production, handling, storage, and disposal of PCBs, dioxins, and furans. PCBs are the compounds relevant to the Barrels, Inc. Site. TSCA does not require removal of the PCB-containing materials in cases where disposal occurred prior to promulgation of TSCA. Where applicable, TSCA identifies incineration, disposal to a chemical waste landfill, or an alternative disposal method which provides adequate protection to health and the environment, as the appropriate disposal methods for PCBs.

### 3.2.3 Michigan Public Act 451, Part 201

The Natural Resources and Environmental Protection Act (PA 451, 1995, as amended) is the State of Michigan equivalent to the federal CERCLA statute. As such, it provides the rules necessary to develop remedial programs and cleanup standards for environmental contamination sites located within the State of Michigan.

The Michigan Act 451 Rules provide for three types of cleanup standards (Residential, Industrial, and Commercial). The selection of a cleanup standard for a particular site is based on site-specific characteristics, the nature of the contamination which exists, and the anticipated future land uses of the property.

A generic approach to developing Generic Industrial or Commercial Remedial Action Plans for industrial sites is provided in the MDEQ ERD Operational Memorandum #14, Revision 2, dated June 6, 1995 (Memo 14). The Generic Industrial or Commercial approach was determined to be generally appropriate for industrial sites with the following characteristics:

- the primary activity at the site is industrial or commercial; and

- the current zoning of the site is industrial or commercial.

The Generic Industrial or Commercial approach includes soil and groundwater cleanup standards for industrial and commercial sites.

A Site-specific Industrial or Commercial cleanup is a health-based approach which allows site-specific characteristics to be factored into a risk assessment. It must be demonstrated that the assumptions used in the risk assessment are appropriate to the site and consistent with reasonably foreseeable current and future land uses. Less conservative exposure assumptions (than Generic Industrial) may be made by assuming less direct contact with the waste materials or restricting current and future use of the site through the application of institutional controls and deed restrictions.

#### 3.2.3.1 Compliance With Michigan Act 451, Part 201

As identified in the RI, the Barrels, Inc. Site is located in an industrial/commercial area. In addition, all adjacent property land uses are industrial or commercial. Based upon the current and reasonably foreseeable future land use of the Site, a Generic Industrial or Site-specific Industrial approach would be the most appropriate method to establish protective cleanup levels at the Site considering the level of study completed to date and the Site-specific factors which have been determined.

Groundwater

MDEQ Memo 14, page 3, indicates that:

*"Groundwater beyond the property boundary would need to be addressed either by remediation or exposure controls."*

Since there are no downgradient users of water from the shallow aquifer, immediate remediation would not be required. Thus, exposure control measures could be enacted to ensure that if a potential exposure was found at some downgradient location, than an action would be conducted to prevent it.

Memo 14, pages 3 and 4, indicate that:

*"Remedial actions to address on-Site groundwater would be determined by the requirements of R299.5705(5) and (6) [unless the Department makes a finding pursuant to Section 20118(5) and (6) that compliance with those subrules is not required]"*

Subrules R299.5705 (5) and (6) pertain to the MDEQ requirements for aquifers which are drinking water sources, to prevent contaminants from spreading, and the need to remediate an aquifer, respectively. It is considered that these subrules do not apply to the Site since groundwater below the Site will not be utilized as a water source. However, groundwater management will be provided to ensure human health.

<u>Soils</u>

Memo 14, pages 5 and 6, indicates that:

*"The generic land-use direct contact criteria are applied like the residential direct contact values, except that the requirement that direct contact be met throughout the affected media will not always apply to industrial/commercial cleanups. It is possible for a generic industrial/commercial RAP to combine the application of these values for shallow soils and land use restrictions to protect against exposure to higher concentrations in deeper soils" and "surface soils are considered to be the top 0-6 inches."*

In general, this approach will be utilized throughout the FS development and screening process.

## 4.0 IDENTIFICATION, DESCRIPTION, AND PRESCREENING OF REMEDIAL TECHNOLOGIES

Prior to the development of a list of potential remedial alternatives, available potentially applicable remedial technologies which could be implemented to fulfill the remedial objectives at the Barrels, Inc. Site are identified and prescreened.

Technologies are engineering or procedural components that may be grouped together or used individually to form a remedial alternative. For example, the technologies of soil removal and incineration, and groundwater control, when grouped together, form a remedial alternative.

The remediation technologies considered in this FS were derived for the remediation of the soil and groundwater media identified as the media of concern. Table 4.1 presents a listing of the potentially applicable remedy types and associated remedial technologies/process options.

Table 4.2 presents a pre-screening of technologies/process options considered applicable to the remediation of the contaminated soil and groundwater at the Barrels, Inc. Site. Each of the response actions and technologies/process options listed is evaluated as to its general technical applicability for implementation at the Site.

The following sections provide a description and technical feasibility evaluation for the remedial technologies/process options considered potentially applicable at the Barrels, Inc. Site.

### 4.1 PHYSICAL CONTAINMENT OPTIONS

The physical containment option involves the use of physical barriers to contain or otherwise restrict the mobility and migration of Site constituents associated with the Site soil. Potential containment options applicable to the Barrels, Inc. Site include one or a combination of the following:

1) berms and ditches; and
2) covering.

### 4.1.1 Berms and Ditches

Berms and ditches could be constructed around the areas of concern to manage affected stormwater and minimize the effects from erosion. This option provides reduction in surficial mobility only. Therefore, this option will not be retained for further evaluation on its own, but will be included to enhance other options.

### 4.1.2 Covering

Covering would involve the construction of a low permeability cover over the areas of concern. The purpose of the cover is to prevent direct contact and to reduce infiltration of precipitation directly through the cover to the affected soils and into the groundwater. In addition, covering provides long-term protection against erosion and subsequent transport of contaminants.

In general, the covering technology provides very good isolation of the Barrels, Inc. Site materials but may extend the length of time that other possible remedy components, such as monitoring, are required.

Materials which may be used in the construction of low permeability covers may include:

1) Asphaltic Concrete Cover; and
2) Soil/Cement Cover.

A brief description and Site-specific screening of each cover technology is presented below.

Asphaltic Concrete Cover

This technology would involve the construction of an asphaltic concrete surface over a compacted granular base of gravel. The granular base would overlie the foundation layer. The required thicknesses of the asphaltic concrete cover and granular drainage base are functions of the degree of anticipated settlement and local climatic conditions.

Asphaltic concrete mixes designed to reduce infiltration are similar to highway paving asphaltic concrete except that the percentages of mineral filler and asphalt cement are increased. These increased percentages serve to increase water repellence and improve weathering characteristics as compared to normal asphaltic pavements.

Asphaltic concrete is designed to retain enough flexibility to mold to slight deformations of the subgrade, and is more resistant to surface cracking than normal Portland concrete.

The increased precipitation runoff resulting from the reduced infiltration capacity of the asphaltic concrete pavement may cause stormwater management concerns. A stormwater management program would need to be implemented.

The asphaltic concrete cover would eliminate contact with the source of contamination, limit leaching to groundwater, and eliminate sediment erosion. Therefore, the asphaltic concrete cover will be retained for further Initial Screening.

Soil/Cement Cover

This technology would involve the construction of a soil/cement mixture over the affected areas. The required thicknesses of this mixture are functions of the degree of anticipated settlement and local climate conditions. The soil would consist of imported clean sand.

This soil/cement cover would eliminate contact with the source of contamination, limit leaching to groundwater, and decrease the mobility of the contaminants contained in the soil which is used in the cover. The soil/cement cover would not be as effective as the asphaltic concrete in limiting leaching to groundwater, due to its more pervious nature. Also, the soil/cement cover would be more susceptible to cracking and would require increased operational costs in comparison to asphaltic concrete. The soil/cement cover will not be retained for Initial Screening.

## 4.2 ON-SITE/IN SITU TREATMENT

The in situ treatment technologies/process options would involve in situ treatment of contaminated soil to Generic Industrial Criteria. The in situ treatment process options considered for the evaluation of the treatment of the constituents identified in the soil at the Barrels, Inc. Site include:

1) Biological;
2) Soil Vapor Extraction;
3) Soil Flushing;
4) Vitrification; and
5) Stabilization/Solidification.

A process description and preliminary evaluation of the in situ process options are presented below:

### 4.2.1 Biological Treatment

In situ biological treatment is a process where oxygen and nutrients are added to soils in situ. These nutrients enhance and expedite the biological degradation of organic contaminants by either indigenous or introduced micro-organisms.

Water is used as a carrier to transfer the oxygen/nutrients/micro-organisms mixture to the subsurface. This is accomplished through infiltration basins at the ground surface or through a series of injection/extraction wells. The injection/extraction wells circulate nutrients, oxygen, and micro-organisms through the contaminated media. Under these conditions the circulating water may also desorb and dissolve contaminants as a soil flushing system. The extracted water may be treated on Site, if required, to remove dissolved contaminants before disposal or reinjection.

Many factors influence the effectiveness of an in situ biological treatment process. These factors include:

- concentration of available oxygen;
- appropriate levels of macronutrients and micronutrients;
- redox potential;
- soil pH;
- degree of water saturation;
- soil temperature;
- presence of toxins;
- biodegradability of contaminants;
- by-products of degradation; and
- hydraulic conductivity of soils.

It is important to note that high concentrations of heavy metals, non-biodegradable toxic organics, alkaline conditions, or acid conditions may interfere with or inhibit the degradation process. The in situ biological treatment system must be engineered to maintain parameters such as pH, temperature, and dissolved oxygen within ranges conducive to the desired microbial activity.

Micro-organisms have been shown to degrade many organics to low parts per million levels, but the results are highly dependent on the conditions mentioned above. Metals are not affected by microbial degradation.

Some work has been done on the use of micro-organisms to degrade PCBs either through enhancing conditions for indigenous micro-organisms or mixing the contaminated material with engineered micro-organisms. A laboratory-scale study has shown that Aroclor 1248 and Aroclor 1260 demonstrate significant resistance to microbial metabolism. A more chlorinated PCB has a generally higher resistance to biodegradation (Bedard, 1989).

Based on the above-noted difficulties in biological treatment of PCBs, as well as the presence of heavy metals, this treatment option will not be retained for Initial Screening.

### 4.2.2 Soil Vapor Extraction

Soil vapor extraction (or soil vacuum extraction) (SVE) is a technique used to remove VOCs and SVOCs from the vadose (or unsaturated) zone. SVE utilizes vapor extraction wells or trenches installed in the contaminated areas of the vadose zone to strip VOCs and SVOCs from the contaminated media. The extraction wells/trenches can be used alone or in conjunction with air injection wells. Air injection wells may use atmospheric air (passive) or forced air injection (active).

The vacuum extraction process is designed to remove chemical vapors trapped in soil pore spaces. However, residual liquid contaminants and dissolved contaminants from the groundwater may be removed to a limited extent. Water vapor in the collected air stream is condensed and separated from the air stream and treated, if required. The air stream is then treated, if required, prior to venting to the atmosphere.

Several factors impact the effectiveness of in situ vacuum extraction at any particular site. These factors include:

- chemicals to be treated and their concentrations;
- soil temperature;
- air conductivity of the soil;
- moisture content;
- geological conditions; and
- soil sorption capacity.

The effectiveness of the SVE process is site specific. The process is best suited for use in permeable, well drained soils with low organic carbon content. Since SVE works only in the vadose zone, the groundwater level is sometimes lowered to increase the volume of the unsaturated zone. Factors such as stratigraphy and soil heterogeneities influence the flow of air as well as the location of contaminants. This will have a pronounced effect on the design of the SVE facility but proper design of the vacuum extraction system may overcome these problems.

As the air travels through the soil, it passes through the pore space that provides the least resistance to air flow. Air that passes through pores containing vapor and liquids will strip the contaminants from the soil. Chemicals existing in a condensed phase will vaporize and this process will continue until the condensed phase organics are removed from the higher permeability soil.

The airflow draws chemical vapors and entrained water from the extraction wells to a vapor-liquid separator. In this unit, the liquid is separated and contained for treatment and vapor is advanced to a vapor treatment unit. Monitoring probes can be installed to measure the soil vapor concentrations and sampling ports can be installed at many stages, as required, following extraction from the well.

Vapors are typically treated using carbon adsorption, thermal destruction or condensation.

SVE is not effective in removing PCB and inorganic constituents from soil media. Also, the lack of an expansive unsaturated sand zone at the Site generally precludes this technology. Therefore, SVE will not be retained for Initial Screening.

### 4.2.3 Soil Flushing

Soil flushing is an in situ process using a groundwater extraction/reinjection system. The soil flushing process consists of injecting a solvent or surfactant solution into the affected soil, to enhance the contaminant solubility. The addition of a solvent/surfactant results in increased recovery of contaminants in the extracted groundwater.

The soil flushing system uses extraction wells installed in the contaminated zone, a reinjection system located upgradient of the contaminated zone, and a wastewater treatment system (if required). Proper control measures must be employed to prevent migration of contaminants via groundwater flow from the area being treated. The use of soil flushing in sandy soils, for example, may result in uncontrolled migration of contaminants whereas the presence of a clay confining layer will inhibit migration. Treatment duration may be reduced through the use of ponds or sprinklers over the contaminated zone to accelerate the flushing of chemicals.

The degree to which soil flushing is effective is primarily dependent upon the following factors:

- soil hydraulic conductivity;
- soil carbon content; and
- chemical-specific properties such as water solubility, adsorption characteristics, vapor pressure, liquid viscosity, and liquid density.

Surfactants can be added to the flushing water to help mobilize chemicals.

The extracted water is treated using appropriate technologies for the treatment of chemicals which are present in the product water. The soil flushing technology is chemical specific and has the greatest success when applied to soils containing only a limited number of chemicals to be treated.

Soil flushing would not provide complete washing of the soil media since the solubilities of the PCBs and inorganics of concern at the Site are low. Also, the large number of low permeability layers would limit the control and collection of flushing liquids. Soil flushing will not therefore be retained for Initial Screening.

### 4.2.4 Vitrification

Soil vitrification is an in situ batch (setting) treatment technology which destroys organic compounds through pyrolysis, and immobilizes inorganics within the resultant solidified mass. Vitrification involves the use of high voltage electrical current transmitted into the soil by large electrodes which transform the soil into a pyrolyzed mass. The contaminants are either thermally destroyed or contained in a resultant glass-like matrix. This technology produces an off-gas waste stream which is captured by a fume hood, and treated to meet air emission regulations, if required. The durability of the resultant solidified mass may be measured on the order of thousands to millions of years. Therefore, long-term management controls would not be required. Long-term monitoring would, however, be required to verify the completeness and effectiveness of this option.

Individual settings, which consist of an array (usually square) of four electrodes spaced at a maximum width of 35 feet, may encompass a total melt mass of 1,000 tons. Vitrification depths as great as 25 feet BGS are considered possible and to date depths exceeding 19 feet BGS have been achieved. Adjacent settings can be positioned to fuse to each other, resulting in a monolithic block of treated waste. The void volume in particulate materials (20 to 40 percent for typical soils) and volatile materials are removed during processing, thus reducing the waste volume.

The electrical power required to vitrify the waste matrix may be obtained from either the local utility distribution system or by an on-Site generator.

The vitrification process is ineffective in conditions where void volumes exceed 150 cubic feet per setting, rubble content exceeds 20 percent by weight and combustible organics exceeds 5 to 10 weight percent, in the soil or sludge.

Although pilot-scale tests have been performed on PCB wastes with satisfactory results, this technology is still relatively unproven for field applications. Also, the power supply costs are generally excessive. Therefore, this technology will not be retained for Initial Screening.

### 4.2.5 In Situ Stabilization/Solidification

In situ stabilization/solidification primarily, but not exclusively, obtains results through the production of a monolithic block of waste with high structural integrity and low hydraulic conductivity (on the order of $10^{-7}$ cm/sec). Contaminants (both organics and inorganics) are mechanically locked within the solidified matrix. Contaminant loss (through leachability) and mobility are minimized through reduction of surface area in contact with the environment. Utilization of cement as a solidifying agent would serve to increase the pH of infiltrating water to a level at which metals are not significantly soluble in water. Stabilization/solidification is an effective method of reducing the mobility of contaminants but may not reduce the toxicity or volume.

There are two processes available for the in situ stabilization/solidification of waste. They are mass mixing and column mixing.

Mass mixing is accomplished using either a hydraulic backhoe bucket or an injection rake mounted to the stick of a backhoe. Where a backhoe with a standard bucket is used, reagents are placed on top of the waste and then thoroughly mixed into the sludge by the backhoe. Injection raking introduces the reagents through the tip of the rake fingers as the soil is being mixed. These methods may be effective where the depth of treatment required is small.

Column mixing employs a crane mounted auger mixing head that is advanced into the waste matrix through a bottom-open cylinder. The chemical reagents are added pneumatically into the soil as the blades rotate and the reagents are mixed through the entire depth of the cylinder. The column mixing process allows containment and collection of vapors and dust emanating from the waste. Containment of volatilized organics could be accomplished through the use of a hood over the mixing column. Head space is kept under negative pressure to draw the vapor and dust into a vapor treatment system.

Following the completion of a cylinder, the mixing blades are retracted and the cylinder assembly is withdrawn. The cylinder is then advanced through the waste at a position located adjacent to the previous cylinder. The process is repeated until the entire waste matrix has been treated.

Quality control for each mixing method is primarily dependent on close inspection of the completeness of mixing of waste material with reagents. Generally mass mixing provides the best results in shallow applications where the effectiveness of mixing may be visually determined. Column mixing provides greater quality control for deeper applications as reagents may be more uniformly applied by injection and completeness of mixing may be monitored based on the duration of agitation (by augering) at the required depth range. Quality control for either method can be verified through sampling and testing for density, viscosity, and bearing strength.

This technology is retained for Initial Screening.

## 4.3 SOIL REMOVAL AND OFF-SITE DISPOSAL

Soil removal would involve the excavation of contaminated soil from the areas of concern for disposal off Site at a licensed facility. The excavated materials would be placed on trucks specially supplied with liners and soil covers to ensure residual materials were not left in the truck beds or blown onto roads.

Excavated materials would be manifested and transported to appropriate landfills permitted to accept the waste materials based on the ARARs discussed in Section 3.0. This technology will be retained for Initial Screening.

## 4.4 EX SITU TREATMENT/OFF-SITE DISPOSAL

The treatment process options considered applicable to the treatment of soil and groundwater at the Barrels, Inc. Site may include:

1) bioremediation;
2) incineration;
3) low temperature thermal desorption;
4) stabilization/solidification;
5) gas-phase chemical reduction; and
6) groundwater pump and treat.

A description and screening evaluation for each treatment process is presented below.

### 4.4.1 Bioremediation

The basis of bioremediation is to provide a favorable environment in which microorganisms may degrade the contaminants to non-hazardous constituents.

The applicability of bioremediation is limited to wastes which are biologically degradable. Bioremediation is not typically effective in removing inorganics or PCBs.

Laboratory-scale studies on the biodegradation of PCBs has shown that Aroclor 1248, 1254, and 1260 are relatively more resistant to biological metabolism in concentrations greater than 5 ppm (Tabak, H.H. et al., October 1981). The conclusion made was that highly chlorinated PCBs, like those identified at Barrels, Inc., are generally resistant to biological degradation.

Based on the above-noted difficulties in biological treatment of PCBs, as well as the presence of heavy metals, this treatment option will not be retained for Initial Screening.

### 4.4.2 Incineration

Incineration is a treatment technology applicable to organic compounds. Incineration uses high temperature oxidation under controlled conditions to degrade a substance into carbon dioxide, water vapor, sulfur dioxide, nitrogen oxides, hydrogen chloride gases and ash. The hazardous products of incineration, such as particulates, sulfur dioxide, nitrogen oxides, and hydrogen chloride may require air emission control equipment (U.S. EPA, October 1988). Incineration may be conducted either on Site or off Site.

One form of on-Site incinerator is the circulating bed combustor (CBC). The CBC incinerator uses lower temperatures (below 1,500°F) than off-Site rotary kiln incinerators, and high combustion air velocities in order to achieve contaminant removal.

A rotary kiln is commonly used for off-Site incineration. Rotary kiln incinerators are cylindrical, refractory-lined shells. They are generally fueled by natural gas, oil, or pulverized coal. Most of the heating of the waste is due to heat transfer with the combustion product gases and the walls of the kiln. The basic rotary kiln incinerator consists of the kiln and an afterburner.

Wastes are fed into the kiln at the higher end and are passed through the combustion zone as the kiln rotates. The rotation creates turbulence which improves combustion. Rotary kilns often utilize afterburners to ensure complete combustion of contaminants. Most rotary kilns are equipped with wet scrubber emission controls.

When soil is incinerated, there is only a small volume reduction. Decontaminated soil/ash may be backfilled on Site following additional treatment to reduce leachability, as necessary.

Inorganic contaminants generally are not affected by incineration and remain in the waste material. As incineration will not remove the inorganics, incineration ash from the Barrels, Inc. Site will contain levels of inorganics which would remain above MDEQ Industrial Criteria. Therefore, the residuals may require additional treatment and/or containment to address inorganics.

Several additional concerns exist with respect to incineration. These concerns include the potential generation of incineration byproducts which may be produced through incomplete combustion and the release of inorganic particulates. Incomplete combustion may result in combustion products which are more toxic than the materials originally being incinerated.

On- or off-Site incineration may be difficult or infeasible to implement due to the following reasons:

- the potential for unacceptable inorganics emissions without installation and maintenance of emission control devices;
- the potential for a lack of public acceptance of the technology;
- the high cost of this technology as compared to other potentially effective technologies for the Barrels, Inc. Site.

Therefore, incineration will not be retained for Initial Screening.

### 4.4.3 Low Temperature Thermal Desorption (LTTD)

Low temperature thermal desorption (LTTD) is a technology which has been developed as an ex situ method of remediating wastes containing organic contaminants. The technology is generally ineffective in removal of inorganic contaminants.

LTTD systems separate organics from waste materials resulting in a significant reduction in waste volume. LTTD is generally applicable to the remediation of volatile organic compounds (VOCs) but it has also been applied to wastes containing semi-volatile organic compounds (SVOCs), polyaromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

Following desorption, the carrier gas may be treated by incineration in an afterburner, or cooled to condense the volatilized water and organics into liquids. The cooled carrier gas may require treatment to meet air quality requirements before venting to the atmosphere. Typical treatment methods include baghouses, cyclone separators, carbon adsorption, or liquid scrubber systems. Carrier gases can also be recycled to the desorber for reuse in oxygen purging.

Residual streams of solid materials include oversized rejects, off-gas particulates, spent carbon, and treated solids. The oversized rejects are usually disposed of in an approved manner off Site or size reduced to allow feeding to the desorber. Particulate matter collected from the gas treatment is usually recycled to the desorber. The spent carbon can be regenerated for reuse. The treated media is sprayed with recycled water to control dust and can generally be backfilled on Site if applicable waste management regulations are met. The process is generally not effective in the treatment of inorganic wastes because inorganics (e.g., metals) have low volatilities. Therefore, if metals are present in the waste stream it will be necessary to stabilize/solidify the treated waste to meet leachability criteria prior to backfilling.

Due to difficulties with treating inorganics with this technology, LTTD will not be retained for Initial Screening.

### 4.4.4 Stabilization/Solidification

The chemical processes involved in the ex situ stabilization/solidification process are identical to those presented for in situ stabilization/solidification (Section 4.2.5). Ex situ stabilization/solidification involves the excavation of the waste material and subsequent batch mixing of the waste with the reagents in a pug mill prior to backfilling.

Stabilization/solidification of the soil at the Site is a viable treatment technology which may be effectively used to reduce the mobility and environmental exposure of Site-related constituents. The stabilization/solidification technology may be implemented utilizing a variety of stabilization/solidification agents and materials. This technology would be useful in stabilizing materials which are found to exceed TCLP analyses, and will be retained for Initial Screening.

### 4.4.5 Gas-Phase Chemical Reduction

Gas-phase chemical reduction (GPCR) is an emerging destruction technology. For solid waste streams the process first involves thermal desorption of the solid waste stream to remove organic contaminants. Desorption is followed by treatment of the desorbed contaminants in the gas-phase utilizing a hydrogen reactor.

Prior to entering the reactor, hydrogen is introduced to the desorbed waste stream. In the hydrogen reactor, the organic contaminants undergo a series of thermochemical reactions at temperatures of 850°C (1,562°F) or higher which cause hydrogen to react with organic constituents such as PCBs, producing smaller lighter hydrocarbons.

Benzene and hydrogen chloride are typical products of a PCB undergoing gas-phase chemical reduction. A secondary reaction serves to reduce benzene and hydrogen to methane gas. Following the reduction of PCBs into methane and hydrogen chloride, the hydrogen chloride (acid gas) and water are removed using a scrubber. A portion of the methane gas product is used as an energy source in the boiler, while the excess methane gas undergoes a water shift reaction which serves to provide a hydrogen source for the reactor.

GPCR has been demonstrated at two sites at the pilot scale with positive results. A pilot study was performed in 1991 at Hamilton Harbour, Ontario on harbor sediments. A second pilot study was conducted in 1992 in Bay City, Michigan under the SITE demonstration program. The SITE demonstration included treatment of PCB contaminated oil, soil, and groundwater. It should be noted, however, that full-scale treatment of PCB containing sludges has not been completed, and although promising, this technology is still unproven.

The GPCR process is ineffective in the treatment of inorganics. Therefore, this technology is not being retained for Initial Screening.

### 4.5 GROUNDWATER

#### 4.5.1 Groundwater Management System

A groundwater management system consists of a group of activities which will be considered a single technology for the purposes of this FS. Groundwater management systems are used at a large number of sites to ensure that affected groundwater does not impact human health or create downgradient environmental degradation. This technology utilizes the natural attenuation ability of the Site groundwater and soils to control the VOCs of concern (benzene and vinyl chloride).

The components of the groundwater management system proposed for the Barrels Site, include:

i) institutional controls to ensure that groundwater below the Site is not utilized as a drinking water source. These controls may be somewhat redundant for the Barrels Site since the area is supplied by municipal water and the county health department has stated that no private wells are located in the area;

ii) groundwater monitoring of the existing wells, to ensure that the Site-related parameters in the groundwater do not migrate off-Site;

iii) preparation of a contingency plan to be enacted if, as part of the monitoring, groundwater is found to migrate, at significant concentrations, near the Site boundary.

Institutional Controls

Institutional controls for groundwater are restrictions placed on the installation of wells and collection, extraction, or use of groundwater from below the Site. These controls could include deed, zoning or building code changes.

Groundwater Monitoring

Groundwater monitoring will be conducted on a semi-annually for the first year, and then yearly, thereafter. Based on current information it is considered that yearly monitoring is justified due to the low compound concentrations and small distance of migration of Site-related compounds to date. Monitoring will be done at all downgradient wells, which include; MW1-47, MW12-31, MW12-45, MW13-33, MW13-49, MW14-31, and MW14-47.

Chemical analysis will be conducted for the VOC list utilized during the RI for consistency and ease of comparison. Water level measurements will be taken at all Site monitoring wells. A report, providing the results of the groundwater monitoring, will be prepared within 1 month of data validation, including hydraulic and water quality data, an assessment of trends or changes in groundwater flow directions and an assessment of water quality changes with respect to the need to enact a Contingency Plan.

Contingency Plan

The contingency plan will contain a set of actions which will be required if the groundwater monitoring indicates that Site-related VOC compounds are approaching the Site boundary at a significant concentration. The following summarizes possible contingency plan actions:

1) contact the laboratory and review QA/QC procedures to ensure the data is correct;
2) resample the affected wells and then sample the affected wells at a quarterly interval until the data indicates that control has been attained. If initial resampling indicates that the affected samples were in error, return to yearly monitoring; and
3) If continued sampling indicates that Site-related affected water may move across the downgradient boundary, install an additional groundwater monitoring well further downgradient to ensure that no adverse effects occur to downgradient receptors if the affected water

extends a significant distance. If it is not possible to install wells further downgradient, due to a technical or logistical concern, or if it becomes apparent that a downgradient shallow aquifer water user would be affected (and the potential receptor can not be provided with an alternative potable water supply), then a groundwater flow barrier (i.e., cut-off wall and/or pumping) would be required to intercept affected groundwater. A pump and treat system would then be designed to remove the VOC of concern and discharge water either back into the aquifer at an upgradient location or into the local POTW.

This option will be retained for Initial Screening.

### 4.5.2 Groundwater Pump and Treat

The groundwater pumping and treatment technology is a well established remedial technology utilized at a large number of sites where contaminated groundwater is a concern. This technology has been utilized to create a downgradient barrier to contaminant migration and/or to attempt to collect contaminated groundwater.

The groundwater pumping and treatment system consists of the installation of extraction wells and pumping equipment, construction of a treatment system capable of reducing contaminants to an accepted discharge standard, and discharge piping to a municipal sewer, drain, or local surface water body.

This technology is generally not effective in remediating low concentration plumes as found at the Barrels, Inc. Site. As such, the groundwater contaminants below the Barrels Site would remain regardless of whether pumping and treating is used. It would likely be effective in creating a downgradient barrier, however, since none of the chemicals of concern attributable to the Site are migrating to the downgradient boundary at Grand River Avenue. The installation would be inefficient, and could create changes to hydraulic gradients which could disperse currently stable distribution of compounds.

In addition, the cost of constructing and operating a groundwater treatment system is very high when compared to the benefits for the Site. This technology is not retained for Initial Screening.

## 4.6 SUMMARY OF PRE-SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

In summary, the following process options and technologies were retained for evaluation for potential implementation at the Site after the pre-screening process:

Physical Containment

- Covering
  - asphaltic concrete cover

On-Site/In Situ Treatment

- Stabilization/solidification

Waste Removal

- Excavation and off-Site Disposal

Ex Situ Treatment/Off-Site Disposal

- Stabilization/solidification

Groundwater

- Groundwater management system

## 5.0 INITIAL SCREENING REMEDIAL ACTION TECHNOLOGIES

As required by Part 201, Rule 513, and the approved FS Work Plan, this section presents an evaluation of removal actions, technologies, or process options applicable to the Barrels, Inc. Site soils, in terms of their effectiveness, implementability, and cost, considering the following:

1) the effectiveness in meeting the cleanup criteria of Part 7 of Part 201, to protect the public health, safety, welfare, and the environment;

2) cost factors, including capital and long-term operation, maintenance, and monitoring; and

3) acceptable engineering practices based on all of the following (implementability):

   i) feasibility for the location and conditions of release;
   ii) applicability to the problem;
   iii) reliability; and
   iv) safety.

This initial screening will effectively narrow the list of potential remedial actions for the development of alternatives.

### 5.1 NO ACTION

The No Action response consists of no remedial action taken. This option must be retained based on the requirement of Rule 513 of Part 201.

The No Action alternative allows the Site to exist as it is without the implementation of any remedial technologies.

Rule 513 of Part 201, and the NCP, require the evaluation of a no action alternative as a basis for comparison with other remedial alternatives, and, as such, the no action alternative is retained throughout the FS evaluation process.

Effectiveness

No measures are taken in the No Action alternative to reduce toxicity, mobility, or volume of Site-related constituents. The No Action alternative does not alter the potential for direct contact with the contaminated soil or consumption of the groundwater of the affected aquifer. In general the No Action alternative is not effective in meeting the cleanup criteria of Part 7 of Part 201.

Cost

There are no costs associated with this alternative.

Implementability

Not Applicable.

Initial Screening Result

Since this alternative is required by Part 201 and the NCP it will be retained for further evaluation.

## 5.2 LIMITED ACTION

The limited action response involves the implementation of institutional controls and property access restrictions to reduce potential human exposure to Site-related constituents.

This action may involve the placement of a restriction within the deed (or other institutional controls such as zoning or building code changes) to the property obligating the property owner to not conduct specific activities (e.g., excavation, residential use) and warn prospective future purchasers of the past history and condition of the property. Deed restrictions can be made enforceable and permanent through various legal mechanisms (e.g., Consent Decree). The use of a deed restriction does not imply that other remedial action technologies are unnecessary. To ensure that the Site does not pose a threat to the environment or to public health may require the implementation of other remedial action technologies in addition to a deed restriction.

Access to the Site may be further restricted by upgrading the existing security fence, constructing additional security fencing, or instituting other controls to minimize entry to the Site by wildlife or unauthorized personnel.

Although the soil and groundwater with contaminant concentrations exceeding potential cleanup goals are not addressed by this option, the implementation of institutional controls and access restrictions would reduce potential future human or wildlife contact with Site-related constituents. As a result limited action is considered applicable and is recommended for inclusion in all remedial alternatives.

Limited Action consists of institutional controls, in the form of deed restrictions (or similar measures), modifications to zoning and building codes, and access restrictions (i.e., upgrading of Site security fencing).

Effectiveness

This action will minimize the potential for direct contact with contaminated soil and consumption of the groundwater at the Site, through the implementation of deed restrictions (or similar measures), modifications to zoning and building codes, and access restrictions.

Cost

The cost of implementing the limited action alternative would be low and is expected to include deed restrictions, modifications to zoning and the building code (as appropriate), ongoing maintenance of Site security fencing, and implementation of a semi-annual monitoring program.

The estimated capital cost associated with the addition of deed restrictions (or similar measures) is $80,600, while security fence maintenance and semi-annual monitoring costs are expected to be $33,000 per year.

Implementability

The addition of deed restrictions (or similar measures), modifications to zoning and building codes, upgrading of the existing security fence would be easily implemented.

Initial Screening Result

Since this alternative provides an acceptable level of protection at a relatively low cost, it is retained for further consideration.

## 5.3 PHYSICAL CONTAINMENT/ASPHALT COVER

Physical containment of the waste material at the Barrels, Inc. Site could be accomplished through the implementation of a low permeability cover. Prescreening of potentially applicable covering materials in Section 5.0 identified asphalt covering as a technically feasible option.

Effectiveness

Construction of a cover over the affected soil at the Site would reduce the risk to human health and the environment as it would remove the threat of direct contact with the contaminated soil. Covering is a proven technology which would reduce infiltration through the covered materials, thus reducing the potential for off-Site migration of Site-related contaminants in the upper water table.

The effectiveness of the asphalt cover would be maintained by annual inspections and patching of cracks, as necessary.

Cost

The cost of an asphaltic concrete cover for the Site is estimated to be approximately $260,000.

The annual costs including groundwater monitoring and cover maintenance are estimated to be $38,000 per year.

Implementability

Construction of an asphalt cover would be performed using locally available materials. Pre-clearing and grading of the area to be covered would be necessary in order to install the asphalt cover

This option would necessitate the control of affected groundwater by the Groundwater Management System.

Initial Screening Result

Since this technology provides an acceptable barrier to human contact and effectively reduces water infiltration at an acceptable cost, it will be retained for further evaluation.

## 5.4 SOIL TREATMENT

All of the treatment options, with the exception of in situ stabilization/solidification, would require excavation of the soils to be treated.

Section 4.0 provided a screening analysis of removal treatment technologies potentially applicable to the Barrels, Inc. Site. The treatment technologies which remain following prescreening include:

- In Situ Stabilization/Solidification; and
- Ex Situ Stabilization/Solidification.

### 5.4.1 In Situ Stabilization/Solidification

Effectiveness

In situ stabilization/solidification may be effective in immobilizing various chemical constituents of soils. It also reduces the potential exposed surface area of the affected soils, by creating a more durable low permeability matrix, thus minimizing the potential for contaminant transfer by leaching.

Stabilization/solidification may produce an alkaline environment causing the precipitation of metals. These precipitates are generally no longer leachable. Other chemicals, such as organic compounds, would be immobilized into the durable, low hydraulic conductivity (usually $10^{-6}$ to $10^{-8}$ cm/sec) matrix. Thus, the potential toxicological impacts to human health and the environment are greatly reduced, if not eliminated, as the affected soil is contained within a monolithic structure.

In situ stabilization/solidification by mass mixing may present potential harmful effects to the on-Site works while the treatment process is in effect. Processing of the affected soils may cause contaminated dust to become airborne. Dust control monitoring and personal protective equipment (PPE) will be necessary to properly maintain the Site conditions within health guidelines.

Stabilization/solidification has been widely used for hazardous waste Site remediation.

Cost

The cost of treatment of the waste matrix using the in situ solidification/stabilization technology may range from $75 to $200 per ton depending upon the method of mixing and the type of reagent used. This cost is relatively high for the relative level of protection to human health and environment, which is low since the concern for direct contact is not eliminated.

Implementability

There are no specific permits required for the implementation of this alternative.

This technology is offered by numerous vendors with experience in earth moving operations and stabilization/solidification treatment processes. With the exception of column mixing, the necessary equipment can be rented by the vendor if they do not own it. In the case of column mixing, several vendors have the equipment and resources required to complete stabilization/solidification of the waste media.

Any storage areas required for temporary stockpiling of material may be accommodated at the Site.

Initial Screening Result

As a result of the relatively high cost associated with the level of protection afforded, this option will no longer be considered.

### 5.4.2 Ex Situ Stabilization/Solidification

Effectiveness

Ex situ stabilization/solidification may be effective in immobilizing various chemical constituents of soils. It also reduces the potential exposed surface area of the affected soils by creating a more durable low permeability matrix, thus minimizing the potential for contaminant transfer by leaching.

Stabilization/solidification may produce an alkaline environment causing the precipitation of metals. These precipitates have very low leachability. Other chemicals, such as organic compounds, would be immobilized into the durable, low hydraulic conductivity (usually $10^{-6}$ to $10^{-8}$ cm/sec) matrix. Thus, the potential toxicological impacts to human health and the environment are greatly reduced, if not eliminated, as the affected soil is contained within a monolithic structure.

Implementation of the ex situ stabilization/solidification technology may release volatile compounds and dust which are potentially harmful to on-Site workers. Excavation, processing, and backfilling of the waste may cause contaminated dust and volatile organic compounds to become airborne. Dust control measures, air monitoring, and personal protective equipment (PPE) may be necessary to properly maintain the Site conditions within health guidelines.

Cost

Ex situ stabilization/solidification costs are approximately $50 per cubic yard. The cost to treat 10,000 cy using stabilization/solidification would be approximately $500,000. It should be noted that ex situ stabilization/solidification would be expected to be marginally more expensive than in situ treatment due to the excavation step required to implement the technology.

Annual costs, including semi-annual monitoring are expected to range from $35,000 to $40,000 per year.

Implementability

There are no permits required for the implementation of this alternative.

This technology is offered by numerous vendors with extensive experience in earth moving operations and stabilization/solidification treatment processes.

Any storage areas required for temporary stockpiling of materials may be constructed on Site.

This technology would involve the use of general excavation/construction equipment which is easily mobilized to the Site.

Initial Screening Result

Due to the high cost and the relatively low level of protection to human health and environment, ex situ stabilization will not be retained for further evaluation.

## 5.5 DISPOSAL

### 5.5.1 Off-Site Disposal

The off-Site disposal option consists of excavating the contaminated soil and disposing at a permitted off-Site landfill.

Effectiveness

Off-Site disposal of the contaminated soil provides an effective option for the Site. Non-hazardous soils exceeding Generic Industrial criteria will be disposed at Type D or C landfills depending on their leachate characteristics. State-of-the-Art TSCA and RCRA landfills are conservatively designed and can reliably contain hazardous soils, such as soils from the PCB hot spot.

Cost

The cost associated with off-Site disposal would be on the order of $30 to $125 per cubic yard for soil transported to a Type D or Type C RCRA landfill, respectively. For the hot spot PCB soil, the cost for disposal is expected to be on the order of $180 per cubic yard. The cost to excavate and dispose the 40 cy of the spot PCB soil would be approximately $8,000. These costs are considered to be relatively low in comparison to other technologies evaluated herein.

Implementability

Standard earth moving equipment would be required to excavate the soil. Licensed waste haulers would transport the soil to the off-Site landfills. Earth moving equipment and waste haulers are generally available and competent, therefore this option is easily implemented. Dust control measures would be taken during implementation of this option.

Initial Screening Result

Due to the ease of implementation and the acceptable cost levels, this technology is retained for further evaluation.

## 5.6 GROUNDWATER MANAGEMENT SYSTEM

Effectiveness

This technology provides a means to control the migration of affected groundwater from below the Site. However, it does not address affected soils, and thus may not be acceptable on its own if the Site is to be utilized for industrial purposes.

Cost

The initial cost associated with this technology is for the preparation of a Contingency Plan. This cost is anticipated to be on the order of $50,000. Annual monitoring costs of approximately $20,000 are also anticipated. These costs assume that the contingency Plan will not be utilized in the future.

Implementability

This technology is easily implemented and is considered to be a well established technology.

Initial Screening Results

Due to the ease of implementation and low cost, this technology is retained to be utilized in conjunction with all other technologies to provide remedial response alternatives.

# 6.0 DEVELOPMENT AND DETAILED EVALUATION OF REMEDIAL RESPONSE ALTERNATIVES

## 6.1 DEVELOPMENT

The list of removal response alternatives, technologies, and process options evaluated in Section 6.0 provides the basis for the development of potential removal action alternatives for further review and analysis. The purpose of this section is to present a series of technically feasible removal action alternatives for further evaluation. These alternatives are identified as follows:

| | |
|---|---|
| Alternative 1 | No Action |
| Alternative 2 | Limited Action |
| Alternative 3 | Asphalt Cover |
| Alternative 4 | Soil Removal (Generic Industrial) and Off-Site Disposal |

Each of these alternatives are discussed in the following sub-sections.

### 6.1.1 Alternative 1 - No Action

Alternative 1, the No Action alternative, assumes that no removal action or maintenance will be conducted at the Site.

The No Action alternative was discussed in Section 5.1.

### 6.1.2 Alternative 2 - Limited Action

Alternative 2 includes institutional controls and access restrictions. In addition, zoning and future land use plans and building codes would be changed to limit the Site use to its current dedicated industrial use. This alternative would limit direct contact with the contaminated soil through the continued use of Site perimeter security fencing and the implementation of further deed and access restrictions. Further discussion regarding the limited action alternative was provided in Section 5.2.

This alternative will also include PCB hot spot removal. Approximately 40 cy of soil containing PCBs will be excavated and transported to an approved off-Site landfill for treatment/disposal. The former hot spot area will be backfilled and verification samples will be taken and analyzed for parameters, including PCBs. This PCB hot spot removal alternative is considered vital to the remediation of the Barrels, Inc. Site and, as such, is included in all the following alternatives.

Regular inspections of the Site would be made to assess the integrity of Site access restrictions and initiate maintenance activities as required.

Also included in this limited action alternative is the cleaning of the tanks located in the Barrels, Inc. building and the subsequent disposal of the waste residuals. Two waste residual samples exceeded RCRA hazardous waste criteria. As a result, this action is also considered vital to the remediation of the Barrels, Inc. Site, and, as such, is included in all of the following alternatives.

This alternative also includes the groundwater management system for the Site. A network of existing monitoring wells would be selected to track groundwater quality and provide warnings if contaminants are detected above regulatory levels. Based on the results of monitoring, additional Site remedies could be implemented in the future as presented in a Contingency Plan, if necessary.

The monitoring program frequency could be increased or decreased in the future, as necessary, to support the ongoing evaluation of Site conditions. The final long-term monitoring program will be incorporated into the RAP. The Site HASP and QAPP will also be amended to address the Remedial Action as part of the RAP preparation. The program could involve the installation of additional monitoring wells, as required.

### 6.1.3 Alternative 3 - Asphalt Cover

Physical containment consisting of an asphalt cover would eliminate the risk associated with direct contact and greatly reduce the potential movement of contaminants through leaching. This alternative will include all the components of Alternative 2.

Alternative 3 consists of constructing an asphalt cover over the contaminated soil using the Generic Industrial criteria. Removal objectives addressed under this alternative include minimizing direct contact with contaminated media and controlling the potential for leaching of hazardous constituents from the waste. Some soils above Generic Industrial criteria would remain on Site, but the cover would serve as an exposure barrier as permitted by the MDEQ Interim Environmental Response Division Operational Memorandum #14, Revision 2.

The asphalt cover would be two layers totaling 3 inches thick over a 6-inch gravel base. The subbase would be graded prior to construction of the cover. The approximate quantities of asphalt, gravel, and materials for grading the subbase are 14,000 sy, 2,400 cy, and 2,000 cy, respectively. The cover will protect an overall area of approximately 14,000 sy.

Stormwater runoff from the cover will be controlled through the use of diversion ditches and erosion controls. Stormwater can be directed to on-Site infiltration galleries or the local municipal stormwater/sanitary sewers.

Alternative 3 would also include the groundwater management system. A network of existing monitoring wells would be selected to track groundwater quality and specifically to monitor the migration of vinyl chloride. Based on the results of monitoring, additional

Site remedies could be implemented in the future based on the requirements of a Contingency Plan.

### 6.1.4 Alternative 4 - Soil Removal (Generic Industrial) and Off-Site Disposal

Alternative 4 consists of excavating approximately 940 cy of contaminated soil above Generic Industrial criteria (in addition to the 40 cy from the PCB hot spot). The extent of the excavation would be verified following the sampling protocol of the MDNR's Verification of Soil Remediation Guidance. This material will then be disposed of at an appropriate off-Site disposal facility. The excavated area will be backfilled and graded. This alternative would also include the components of Alternative 2, limited action.

Alternative 4 would also include the groundwater management system. A network of existing monitoring wells would be selected to track groundwater quality and specifically to monitor the potential migration of vinyl chloride. Based on the results of monitoring, additional Site remedies could be implemented in the future based on the requirements of a Contingency Plan.

Alternative 4 would also include ditch stabilization to prevent erosion of the drainage ditch area, which could lead to migration of chemicals of concern. A typical material such as "riprap" would be used to stabilize the ditch.

## 6.2 DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

In this section, the results of the detailed evaluation and comparison of alternatives will be presented. The evaluation criteria specified in Michigan's Act 307 Rules, specifically Rule 299.5513 (3) and (4), and the National Oil and Hazardous Substances Pollution Contingency Plan

(NCP - 40 CFR 300.430) form the basis for the evaluation and comparison. These evaluation criteria include:

- Assessment of the effectiveness of the alternative in protecting the public health, safety, welfare, or the environment (Protection of Public Health, Safety, Welfare, and the Environment).

- Refinement and specification of alternatives in detail (this was presented in Section 6.1).

- Detailed cost estimation, including operation and maintenance costs, distributed over time, of implementing the final remedy (Costs).

- Evaluation in terms of engineering implementation (Engineering Implementation).

- Evaluation of technical feasibility (Technical Feasibility).

- Analysis of whether recycling, reuse, waste minimization, waste biodegradation, waste destruction, or other advanced, innovative, or alternative technologies are appropriate (Appropriateness of Advanced, Innovative or Alternative Technologies).

- An analysis of any adverse environmental impacts, methods of mitigation, and costs of mitigation (Associated Adverse Environmental Impacts).

- Analysis of the risks remaining after implementation of the remedy (Risks Remaining After Implementation).

- Analysis of the extent to which the alternative attains or exceeds legally applicable or relevant and appropriate federal and state public health and environmental requirements (Ability to Achieve ARARs).

Following the evaluation of each alternative individually, the remedial alternatives are compared to one another based on the ability of the alternatives to satisfy the evaluation criteria.

The following section discusses the evaluation criteria, and subsequent sections present the results of the evaluation and comparative analyses.

### 6.2.1 Evaluation Criteria

The evaluation criteria, as used throughout this report, have the following definitions:

#### 6.2.1.1 Protection of Public Health, Safety, Welfare, and the Environment

This criterion considers whether the alternatives adequately protect public health, safety, welfare, and the environment, both in the short and long term. Attention is given to the extent to which a remedial alternative eliminates, reduces, or controls exposures to constituents of concern. Protection of public health, safety, welfare, and the environment draws on the assessments of other evaluation criteria, particularly associated adverse environmental impacts, risks remaining after implementation, long-term effectiveness and permanence, and short-term effectiveness.

Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence considers the adequacy and reliability of the controls that would be depended upon to prevent future releases from the Site.

Short-Term Effectiveness

Short-term effectiveness assesses the potential short-term risks associated with implementation of the alternatives. Such risks include risks to the surrounding community, risks to on-Site workers, and risks to the environment. The effectiveness and reliability of potential protective measures are also assessed.

### 6.2.2 Cost

Cost refers to the net present value of the alternatives and includes capital costs and operation and maintenance costs. In this evaluation, a discount rate (the difference between the rate of return and the inflation rate) of 5 percent and a time period of 30 years were used to determine net present value.

An alternative must be considered cost effective to be eligible for selection. Cost effectiveness is determined by comparing the overall effectiveness of the remedial alternative to the cost.

### 6.2.3 Engineering Implementation/Technical Feasibility

Acceptable engineering practices include the feasibility (i.e., implementability), applicability, and reliability of the alternative, taking into consideration Site-specific conditions. Feasibility includes the technical and administrative ease with which an alternative may be implemented, and include such factors as technical difficulties and unknowns associated with the construction and operation of an alternative, the ability to secure necessary approvals and permits, and the availability of services and materials.

### 6.2.4 Appropriateness of Advanced, Innovative, or Alternative Technologies

This criterion considers an analysis of whether recycling, reuse, waste minimization, waste biodegradation, waste destruction, or other advanced, innovative, or alternative technologies are appropriate.

### 6.2.5 Associated Adverse Environmental Impacts

Associated adverse environmental impacts refers to unintended and unavoidable consequences which would be brought about by implementation of the remedial alternatives that would adversely impact the surrounding environment.

### 6.2.6 Risks Remaining After Implementation

This criterion assesses the residual risk remaining upon completion of the remedy.

### 6.2.7 Ability to Achieve ARARs

This criterion considers whether a remedial alternative could achieve legally applicable or relevant and appropriate federal and state public health and environmental requirements (ARARs). ARARs are either location specific, activity specific, or chemical specific. Location-specific ARARs are restrictions on activities that can be undertaken at a site based solely on the site's location. There are no potential location-specific ARARs for the Barrels, Inc. Site.

Action-specific ARARs are determined by the specific activities included in the remedial alternatives being considered. Potential action-specific ARARs include RCRA, TSCA, and the Michigan Hazardous Waste Management Act (HWMA).

Chemical-specific ARARs are determined by the level of specific chemicals in the media of concern as compared to that allowed by applicable or relevant and appropriate regulations. For example, U.S. EPA's Ambient Water Quality Criteria developed pursuant to the Clean Water Act are numerical goals for surface water quality. Chemical-specific ARARs potentially applicable include the State of Michigan Natural Resources and Environmental Protection Act.

## 6.3 EVALUATION OF ALTERNATIVES

In this section, the alternatives developed in Section 6.1 will be evaluated based on their ability to satisfy the evaluation criteria.

### 6.3.1 Alternative 1 - No Action

*Protection of Public Health, Safety, Welfare and the Environment* - The No Action alternative is not protective of public health, safety, welfare, and the environment. Since this alternative would not result in any further Site remediation, the magnitude of the residual risks would decrease slowly with time due to natural attenuation and degradation. The No Action alternative would not be effective in the short term. However, there would be no additional risk.

*Cost* - There are no costs associated with the No Action alternative.

*Engineering Implementation/Technical Feasibility* - This alternative is easily implemented, and is also technically feasible.

*Appropriateness of Advanced, Innovative, or Alternative Technologies* - This alternative does not apply any advanced, innovative, or alternative technologies.

*Associated Adverse Environmental Impacts* - No adverse environmental impacts are associated with the No Action alternative.

*Risks Remaining after Implementation* - Risks remaining after implementation would be equivalent to the present risks, however, these risks would decrease over time.

*Ability to Achieve ARARs* - This alternative would result in the exceedance of chemical-specific ARARs, particularly Part 201 of Michigan Public Act 451.

### 6.3.2 Alternative 2 - Limited Action

*Protection of Public Health, Safety, Welfare, and the Environment* - Under this alternative, access restrictions would prevent people from coming into contact with the soils. However, exposure could potentially still occur through inhalation or direct contact by trespassers. Therefore, Alternative 2 is somewhat protective of public health, safety, and welfare. This alternative would also remove the PCB hot spot. Therefore, Alternative 2 is also somewhat protective of the environment. This alternative is expected to offer a high degree of long-term effectiveness and permanence in reducing the potential for contact with soils. The access restrictions are easily maintained and would be effective for the foreseeable future and also the short term. Groundwater monitoring would be effective in monitoring the migration of the contaminant plume and, thereby, protecting the public health, safety, and welfare.

*Cost* - The estimated cost for this option is approximately $80,000 in capital costs and approximately $33,000 in annual operation and maintenance costs. The estimated present worth cost, over a 30-year period using a discount rate of 5 percent, is approximately $653,000. Table 6.1 presents a detailed cost estimate for Alternative 2.

*Engineering Implementation/Technical Feasibility* - Generally, institutional controls (deed restrictions, zoning ordinance, or building code changes) and

Site monitoring plans are easily implemented over a period of a few months. The PCB hot spot removal can also be easily implemented and is technically feasible, as excavation and off-Site disposal are accepted practices.

*Appropriateness of Advanced, Innovative, or Alternative Technologies* - This alternative does not apply any advanced, innovative, or alternative technologies. It does result in the removal of the PCB hot spot.

*Associated Adverse Environmental Impacts* - No adverse environmental impacts are associated with this alternative.

*Risks Remaining after Implementation* - Risks remaining after implementation would be less than the existing risks, due to the additional precautions to prevent contact with the soils and the removal of the PCB hot spot.

*Ability to Achieve ARARs* - This alternative would result in the exceedence of chemical-specific ARARs, particularly Part 201 of Michigan Public Act 451.

### 6.3.3 Alternative 3 - Asphalt Cover

*Protection of Public Health, Safety, Welfare, and the Environment* - This alternative would reduce the risks to human health and the environment. The placement of the cover would remove the pathway for direct contact with chemicals in the surface soils by the Site workers, reduce potential for migration of affected soil particles through surface water runoff into the drainage ditch, and reduce potential emissions to the atmosphere of chemicals in the near surface soils. In addition, the groundwater contaminant plume would be monitored. Access to the Site would be restricted by realigning existing Site security fencing or constructing additional fencing, if required. Construction of the cover would reduce infiltration and thereby reduce the potential for chemical migration through groundwater flow. Implementation of Alternative 3 would eliminate potential risks due to direct contact/ingestion of soil and reduce infiltration thereby reducing the chemical migration into the groundwater. Potential risks from chemicals in the ambient air would also be reduced by the covering action. Provided that the cover is regularly maintained, the covering action is considered to have high reliability. The potential for human contact with soils would be increased during construction, however, all construction activities would be completed in accordance with federal and state regulations regarding worker safety, dust control and air emissions, and erosion control.

*Cost* - The estimated cost for Alternative 3 is approximately $334,000 in capital costs and approximately $40,000 in annual operation and maintenance costs. The estimated present worth cost of Alternative 3, over a 30-year period using a discount rate of 5 percent, is approximately $1,097,000. Table 6.2 present detailed cost estimates for Alternative 3.

*Engineering Implementation/Technical Feasibility* - Alternative 3 is technically feasible. Alternative 3 is applicable to Barrels, Inc., as it addresses the remedial action objective of reducing the direct contact exposure to affected soils. Additionally, Alternative 3 is expected to be reliable, as covering is a well established technology and is easily implemented.

*Appropriateness of Advanced, Innovative, or Alternative Technologies* - This alternative does not apply any advanced, innovative or alternative technologies. It does result in the removal of the PCB hot spot and minimization of the mobility of compounds.

*Associated Adverse Environmental Impacts* - No adverse environmental impacts are associated with this alternative.

*Risks Remaining after Implementation* - The potential for contact with the soils would be eliminated, therefore no risks would remain after implementation of this alternative provided that the asphalt cover is maintained.

*Ability to Achieve ARARs* - This alternative would provided a barrier to prevent exposure to the chemicals of concern, although affected soils exceeding Generic Industrial Criteria would remain on Site, as permitted by the MDEQ Interim Environmental Response Division Operational Memorandum #14, Revision 2. This alternative would meet the requirement of being protective of human health and the environment in addition to reducing the mobility of the chemicals of concern for the PCB hot spot area.

### 6.3.4 Alternative 4 - Soil Removal (Generic Industrial) and Off-Site Disposal

*Protection of Public Health, Safety, Welfare, and the Environment* - The excavation, transport, and disposal of soil above the Generic Industrial criteria at an approved off-Site landfill may be performed in a manner which is protective of human health and the environment. The removal of the soil would remove the potential for direct contact with chemicals in the surface soils by the Site trespassers, reduce potential for contaminant migration through surface water runoff into the drainage ditch and through groundwater flow, and reduce potential emissions to the atmosphere of chemicals in the near surface soils. Alternative 4 provides for the permanent removal of the source of risk, using Generic Industrial criteria, for the Site. In addition, the groundwater contaminant plume would be monitored. The potential for human contact with soils would be increased during implementation of Alternative 4. However, workers would be required to wear appropriate personal protective equipment and adhere to safe construction practices to minimize potential hazards.

Cost - The estimated cost for Alternative 4 is approximately $356,000 in capital costs and approximately $33,000 in annual operation and maintenance costs. The estimated present worth cost of Alternative 4, over a 30-year period using a discount rate of 5 percent, is approximately $1,048,000. Table 6.3 presents a detailed cost analysis of this alternative.

*Engineering Implementation/Technical Feasibility* - Alternative 4 is technically feasible. Alternative 4 is applicable to Barrels, Inc., as it addresses the remedial action objective of reducing the direct contact exposure to affected soils. Additionally, Alternative 4 is expected to be reliable, as excavation and disposal to an Off-Site landfill are well established technologies and can be easily implemented.

*Appropriateness of Advanced, Innovative, or Alternative Technologies* - This alternative does not apply any advanced, innovative, or alternative technologies. It does result in the removal of the PCB hot spot. Alternative 4 provides a highly effective measure of reduction in the mobility of the Site constituents. This reduction is achieved through containment in approved off-Site landfill cells. In this way, the soil will be permanently isolated from the environment. Long-term monitoring at the landfill would ensure that the affected soil remains controlled.

*Associated Adverse Environmental Impacts* - Some concerns may exist regarding the transport of affected soil over public roads.

*Risks Remaining after Implementation* - The potential for contact with the soils would be eliminated at the Site.

*Ability to Achieve ARARs* - This alternative would meet the requirements of being protective of human health and the environment in addition to reducing the mobility of the chemicals of concern for the PCB hot spot area. Alternative 4 would also meet the requirements of the Environmental Response Division Operational Memorandum #14, Revision 2, which facilitates the implementation of the 1995 amendments to Part 201 of the Natural Resources and Environmental Protection Act, 1994 PA 451 (formerly the Michigan Environmental Response Act).

# 7.0 REMEDIAL ALTERNATIVE SELECTION

## 7.1 COMPARISON OF ALTERNATIVES

In this subsection, the alternatives will be compared to one another in terms of their ability to satisfy the evaluation criteria.

### 7.1.1 Protection of Public Health, Safety, Welfare, and the Environment

All of the alternatives evaluated, with the exception of the No Action alternative are protective of public health, safety, welfare, and the environment to some degree. At a minimum each alternative removes the PCB hot spot area. Groundwater monitoring is also included in each alternative, protecting public health, along with deed restrictions prohibiting the pumping of on-Site groundwater.

Alternative 2 is less protective of human health and environment than the remaining alternatives. This alternative only uses access restrictions to prevent humans from coming into contact with the soil. However, Alternative 2 does not prevent exposure to potentially affected airborne constituents. Alternative 3 would be more protective of human health and environment. In this alternative, contact with the source is eliminated provided the cover is maintained, the occurrence of airborne constituents is eliminated and downward migration is minimized. Alternative 4 is highly protective of human health and environment. This alternative eliminates the source, using Generic Industrial Criteria.

#### Long-Term Effectiveness

Alternative 1 does not result in any Site remediation. Alternatives 2 and 3 would offer a high degree of long-term effectiveness and permanence provided that they are properly maintained. By removing the source, Alternative 4 provides long-term effectiveness and permanence.

Short-Term Effectiveness

Alternative 1 would not be effective in the short term, unlike Alternative 2. Alternatives 3 and 4 would increase the potential for human contact with soils during implementation. However, workers would be required to wear appropriate personal protective equipment and adhere to safe construction practices to minimize potential hazards.

### 7.1.2 Cost

The estimated costs, on a present worth basis associated with each of the alternatives are as follows:

| | | | |
|---|---|---|---|
| • Alternative 1 | - | No Action | $ 0 |
| • Alternative 2 | - | Limited Action | $ 653,000 |
| • Alternative 3 | - | Asphaltic Concrete Cover | $1,097,000 |
| • Alternative 4 | - | Soil Removal (Generic Industrial) and Off-Site Disposal | $1,048,000 |

The costs associated with Alternative 1 (No Action) and Alternative 2 (Limited Action) are considerably less than the costs associated with the other alternatives. Alternatives 3 and 4 are expected to cost close to 1 million dollars over a 30-year period.

### 7.1.3 Engineering Implementation/Technical Feasibility

All of the alternatives are technically feasible and employ proven technologies. In addition, each alternative could be easily implemented.

### 7.1.4 Appropriateness of Advanced, Innovative, or Alternative Technologies

None of the options employ advanced, innovative, or alternative technologies. However, all are easily implemented and have been used extensively.

### 7.1.5 Associated Adverse Environmental Impacts

Alternatives 1, 2, and 3 have no associated adverse environmental impacts. Alternative 4 may have some concerns regarding the transportation of affected soil over public roads.

### 7.1.6 Risks Remaining after Implementation

Alternative 1 would have only present risks remaining after implementation. The remaining alternatives would have various amounts of risks remaining after implementation, provided that they are properly maintained.

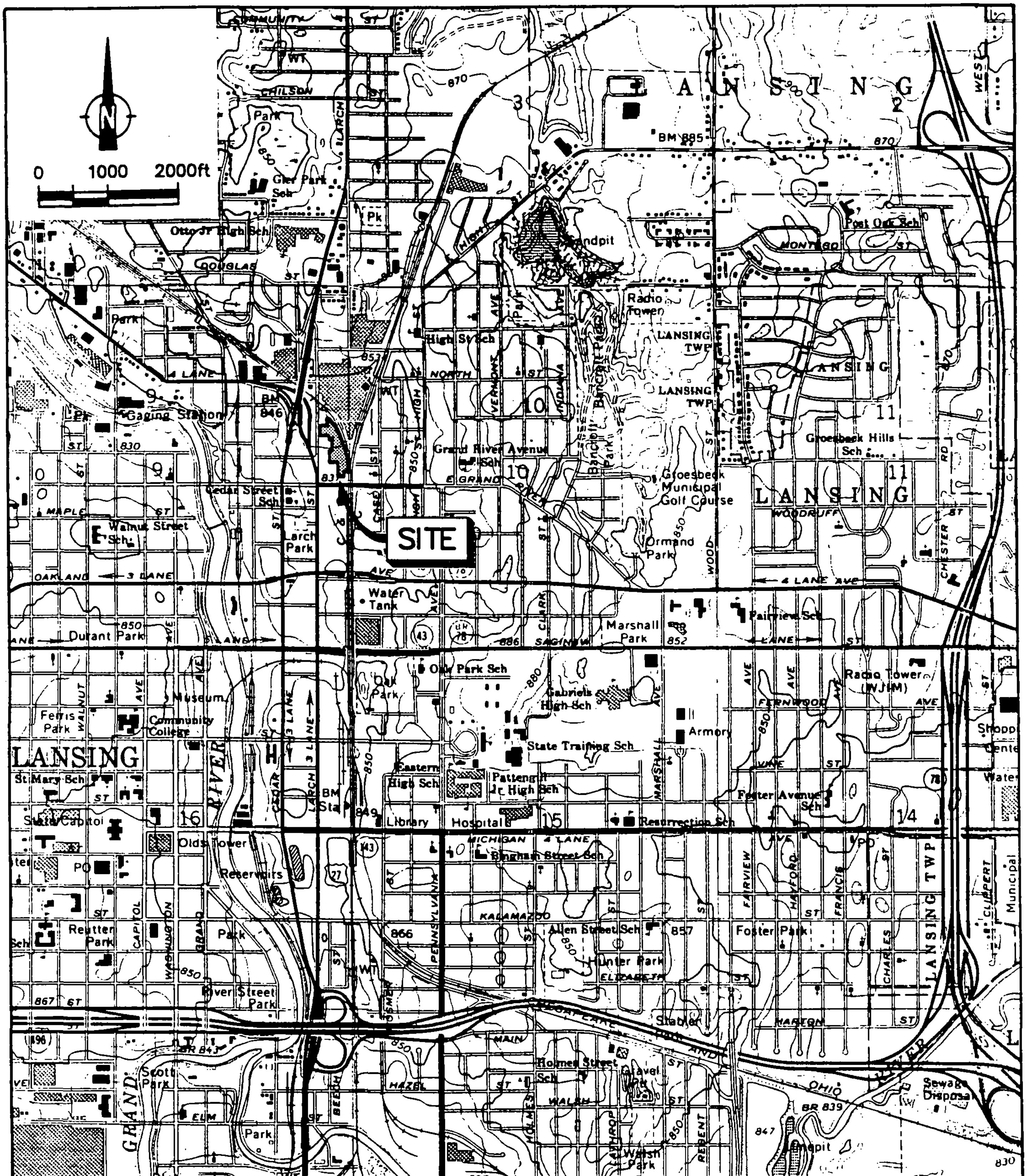
### 7.1.7 Ability to Achieve ARARs

Alternatives 1 and 2 would result in the exceedence of chemical-specific ARARs, particularly Part 201 of Michigan Public Act 451. Alternatives 3 and 4 would meet the requirement of being protective to human health and the environment in addition to reducing the mobility of the chemicals of concern.

## 7.2 SELECTED ALTERNATIVE

Alternative 3, which includes deed restrictions to ensure the Site remains industrial and that groundwater is not utilized, PCB hot spot removal, and covering the Site soils with an asphalt cover, along with groundwater monitoring, ditch stabilization and stormwater control, is considered the most appropriate option for the Barrels, Inc. Site. Alternative 3 is protective of public heath, safety, welfare, and the environment; is cost effective; employs acceptable engineering practices; and would comply with ARARs. Additionally, an evaluation of the alternatives with respect to associated adverse environmental impacts; risks remaining after implementation; long-term effectiveness; and reduction of toxicity, mobility, or volume demonstrates that Alternative 3 affords the best combination of attributes.

Alternative 3 was among the alternatives identified as having low adverse environmental impacts and risks remaining after implementation. By covering the source, this alternative had a high degree of long-term effectiveness and permanence and a high degree of protection of public health, safety, welfare, and the environment, as well as reducing the mobility of affected soil. Using appropriate personal protective equipment and adhering to safe construction practices during implementation would make this alternative effective in the short term. Moreover, this alternative was very cost effective at providing an overall level of protection and complying with ARARs.




SOURCE: USGS QUADRANGLE MAPS,
NORTH LANSING AND SOUTH LANSING, MICH.


figure 2.1

SITE LOCATION
BARRELS, INC. SITE
*Lansing, Michigan*

CRA

4869 (16) OCT 16/95 (W) REV.0

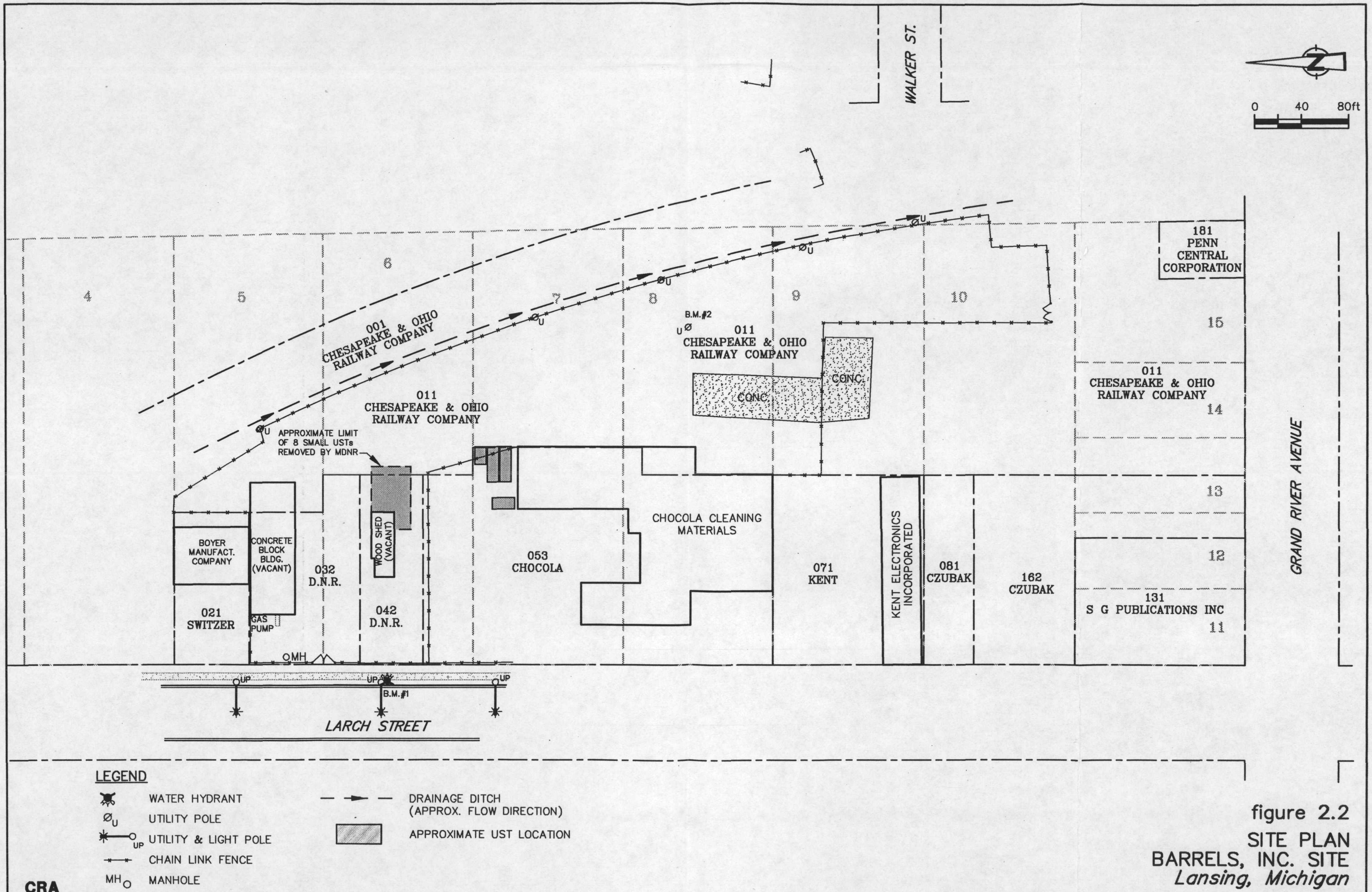
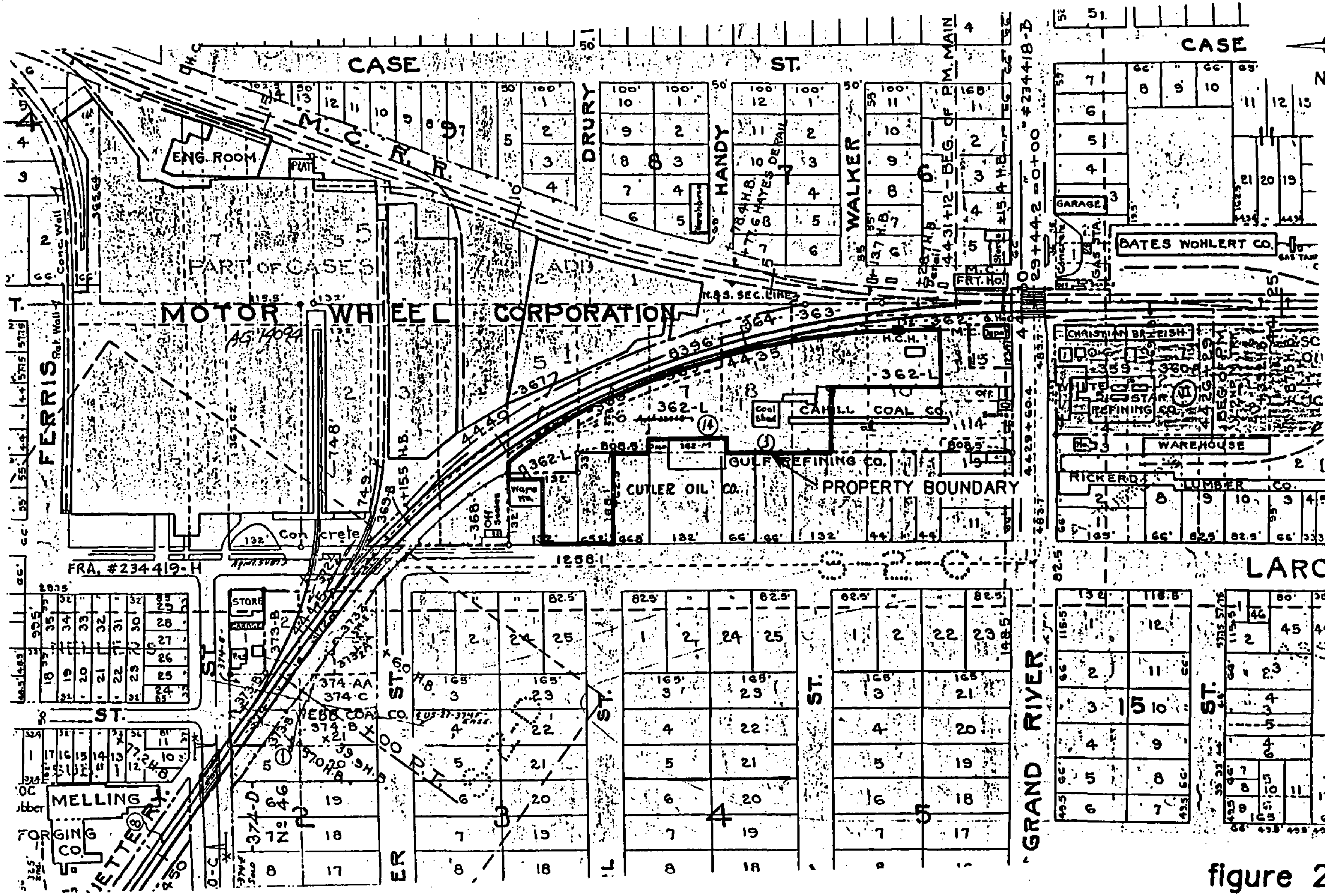



figure 2.2
SITE PLAN
BARRELS, INC. SITE
*Lansing, Michigan*

CRA

4869 (16) OCT 16/95(W) REV.0 (P-76)



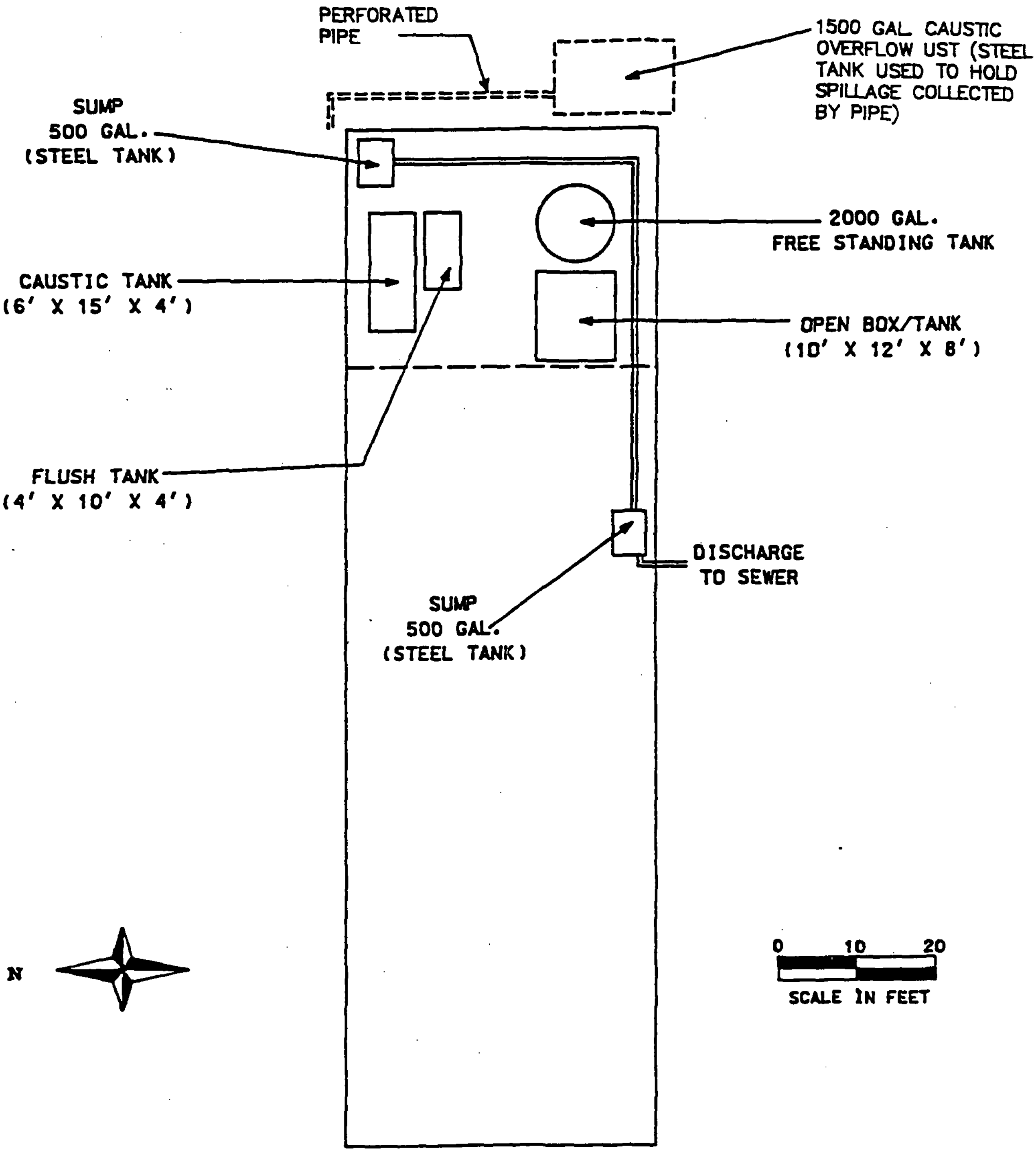

SOURCE: CSXT PLAN
DATE UNKNOWN

figure 2.3

**HISTORICAL SITE USAGE**
**BARRELS, INC. SITE**
*Lansing, Michigan*

**CRA**

4869 (16) OCT 16/95 (W) REV.0



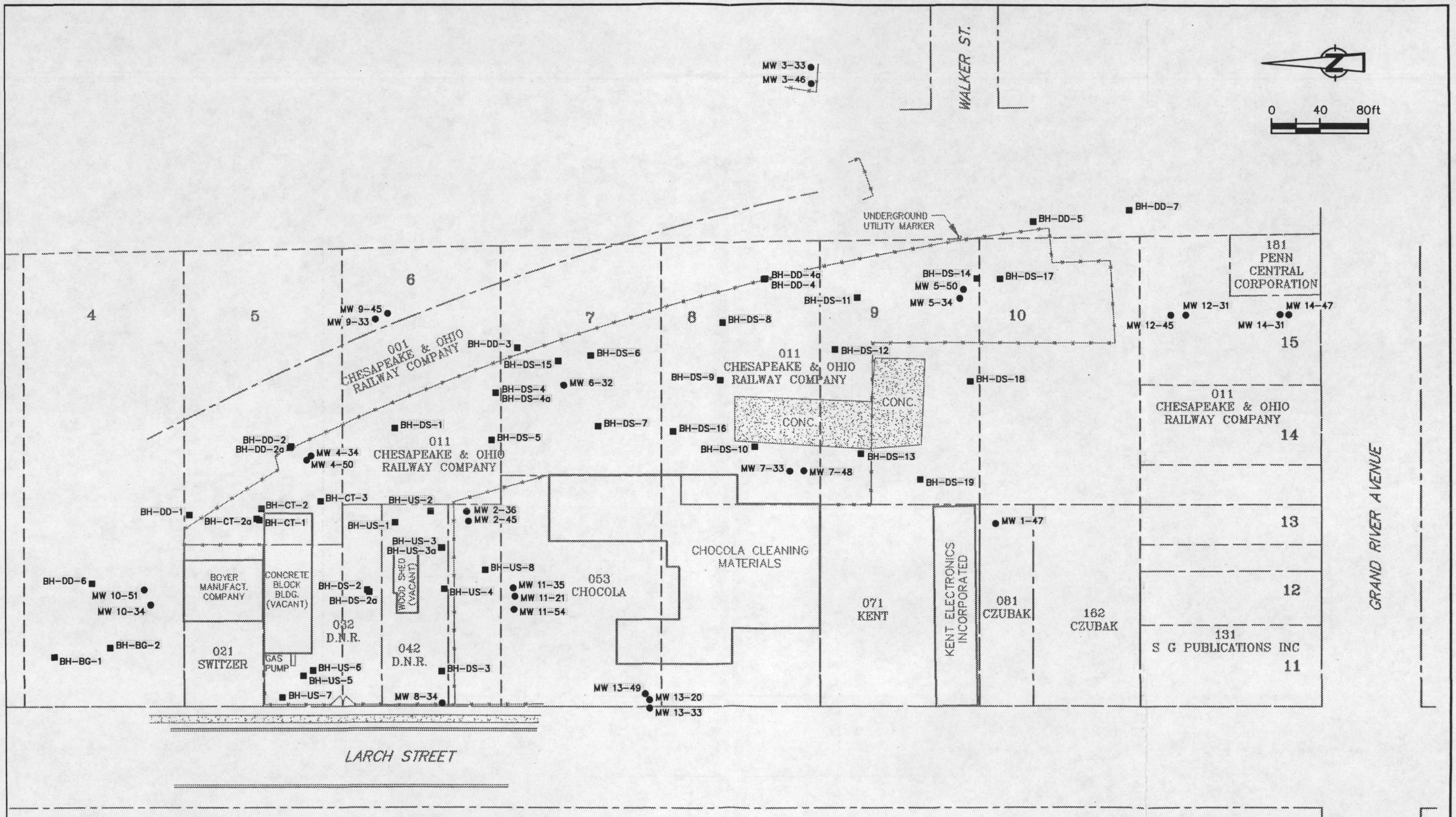

SOURCE: HALIBURTON NUS, FEBRUARY, 1992

figure 2.4

BUILDING SCHEMATIC
BARRELS, INC. SITE
*Lansing, Michigan*

CRA

4869 (16) OCT 16/95 (W) REV.0




**LEGEND**

- CHAIN LINK FENCE
- ● MONITORING WELL
- ■ SOIL BORING

**NOTE**

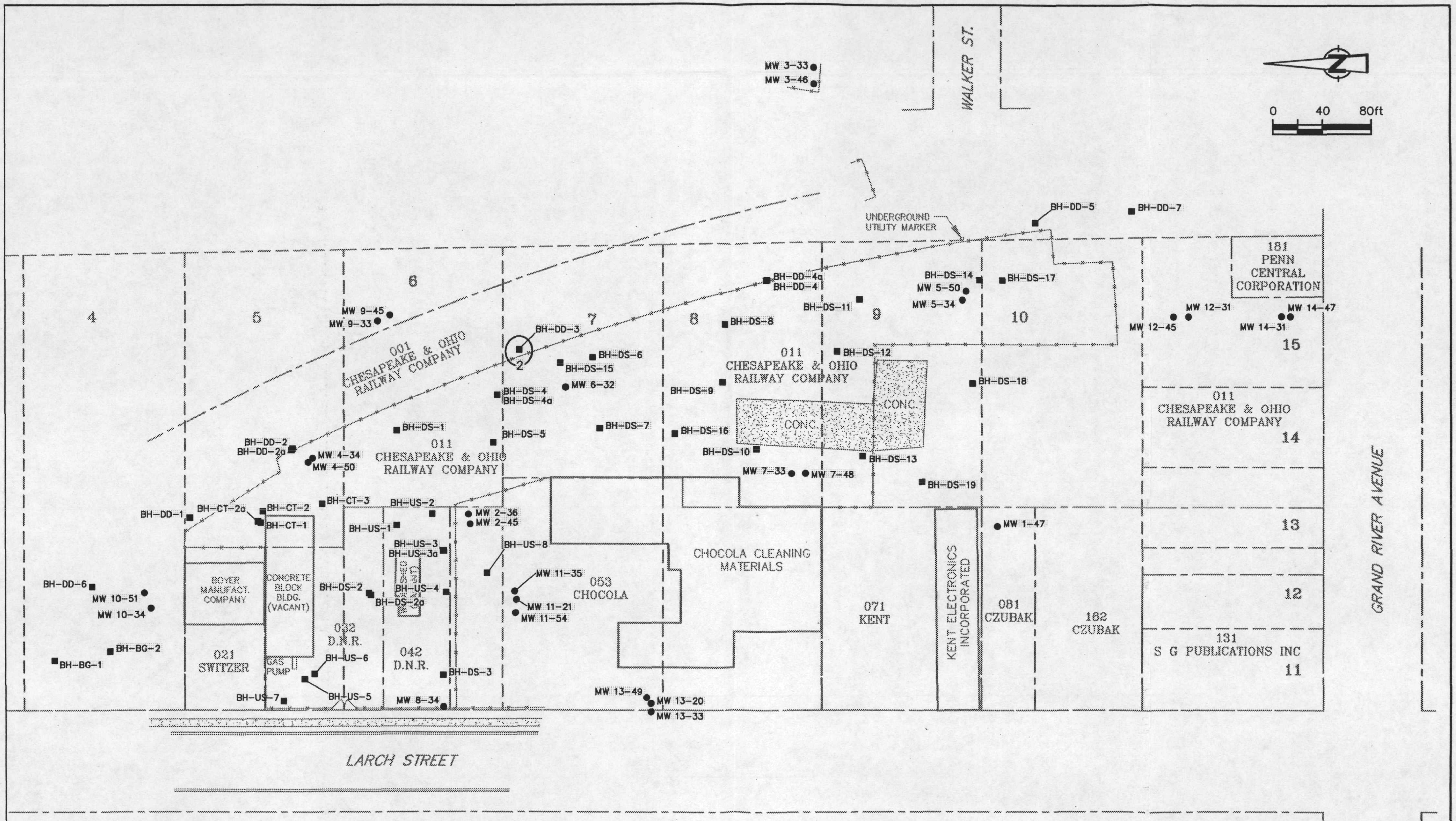
NO SOILS EXCEED THE INDUSTRIAL CRITERIA FOR VOCs

figure 2.5

EXTENT OF SOILS EXCEEDING INDUSTRIAL CRITERIA FOR VOCs
BARRELS, INC. SITE
*Lansing, Michigan*

CRA

4869 (16) NOV 02/95(W) REV.1 (P-77)




**LEGEND**

CHAIN LINK FENCE

MONITORING WELL

SOIL BORING

—2— EXTENT OF SVOCs EXCEEDING INDUSTRIAL CRITERIA (AT 2 FT. BGS)

figure 2.6

EXTENT OF SOILS EXCEEDING INDUSTRIAL CRITERIA FOR SVOCs
BARRELS, INC. SITE
*Lansing, Michigan*

CRA

4869 (16) NOV 02/95(W) REV.1 (P-78)

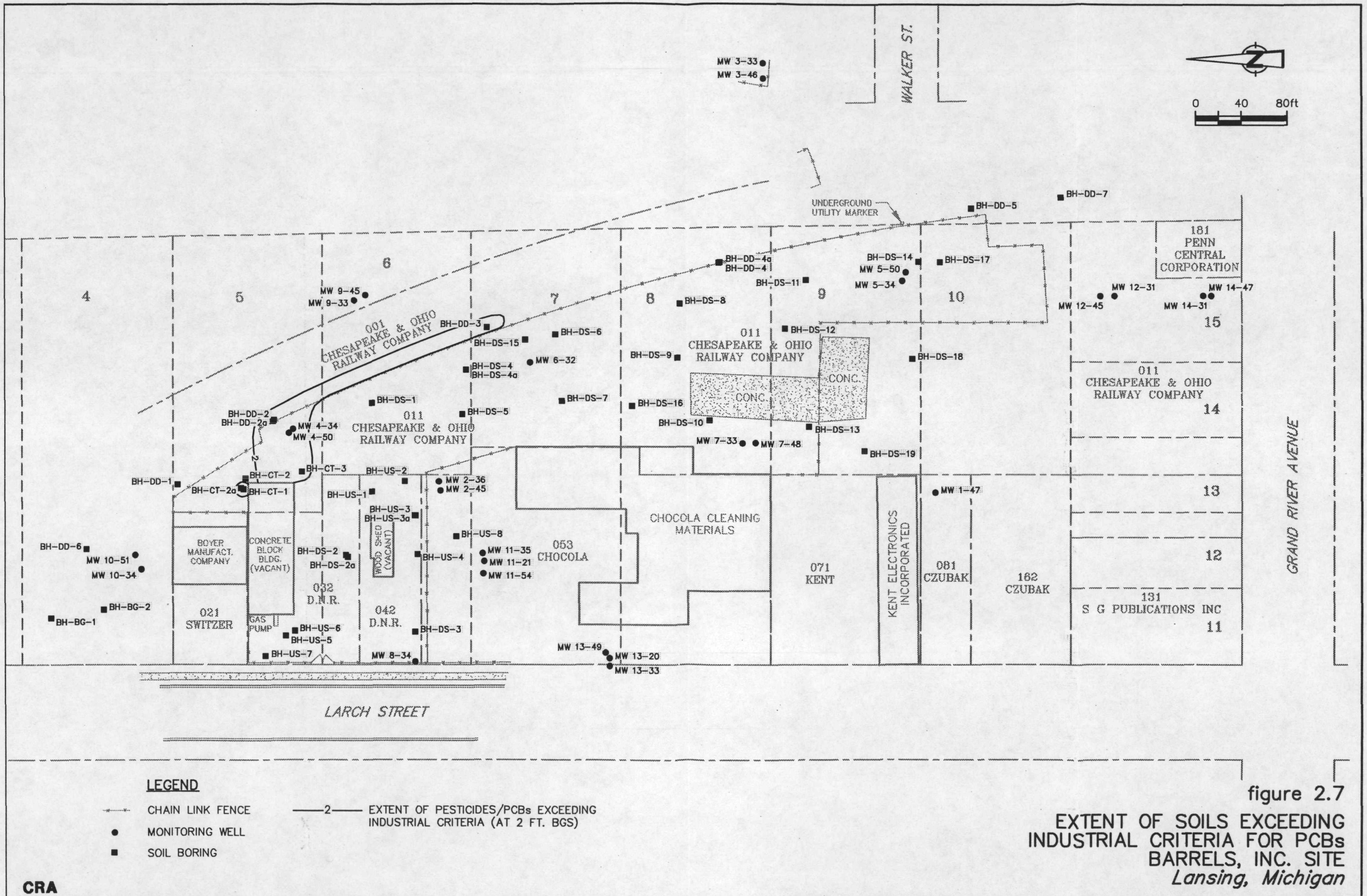
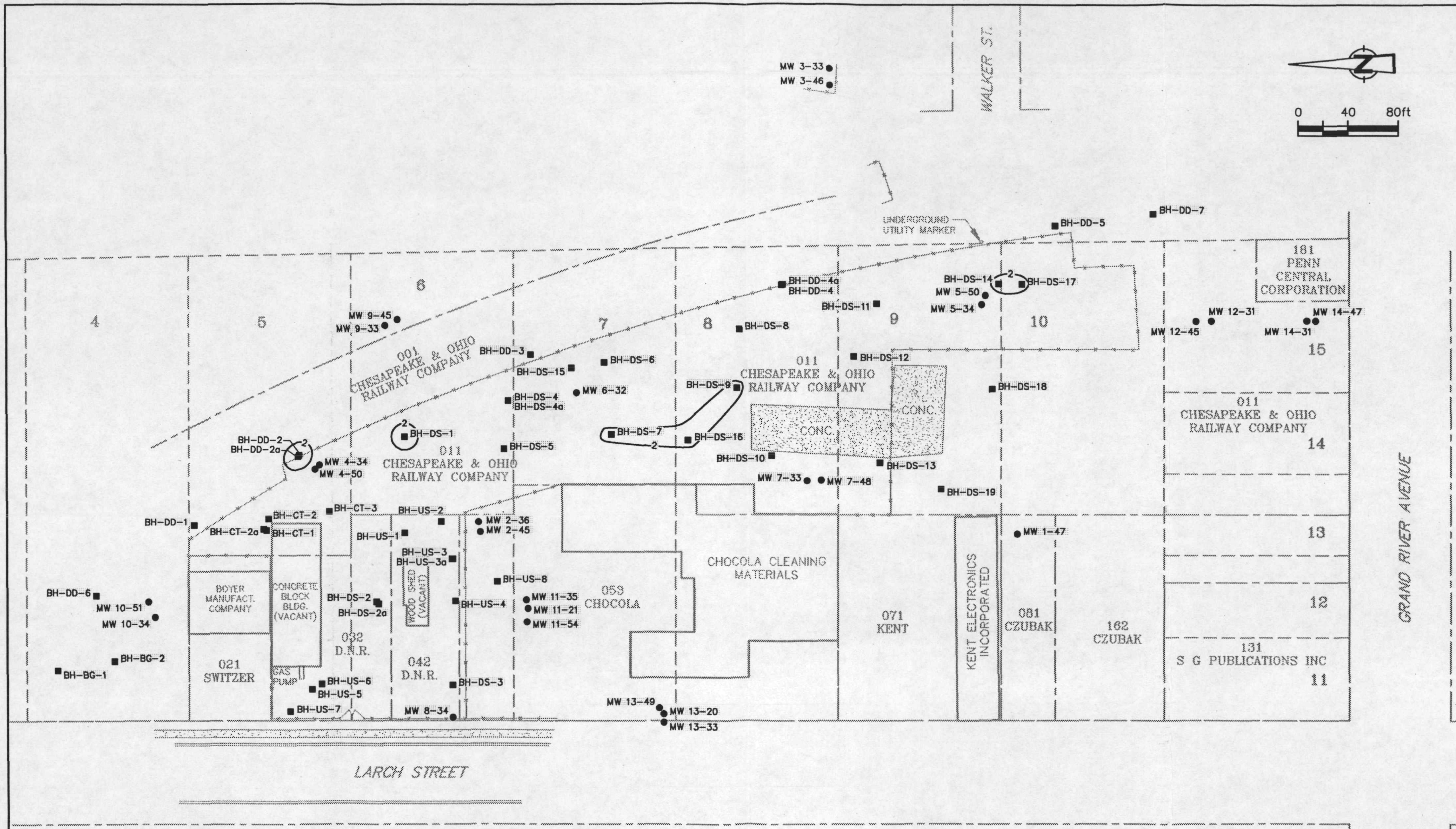



figure 2.7

EXTENT OF SOILS EXCEEDING INDUSTRIAL CRITERIA FOR PCBs
BARRELS, INC. SITE
*Lansing, Michigan*




**LEGEND**

- CHAIN LINK FENCE
- ● MONITORING WELL
- ■ SOIL BORING
- —2— EXTENT OF INORGANICS EXCEEDING INDUSTRIAL CRITERIA (AT 2 FT. BGS)

figure 2.8

EXTENT OF SOILS EXCEEDING
INDUSTRIAL CRITERIA FOR INORGANICS
BARRELS, INC. SITE
*Lansing, Michigan*

CRA

4869 (16) JAN 22/96(W) REV.1 (P-80)

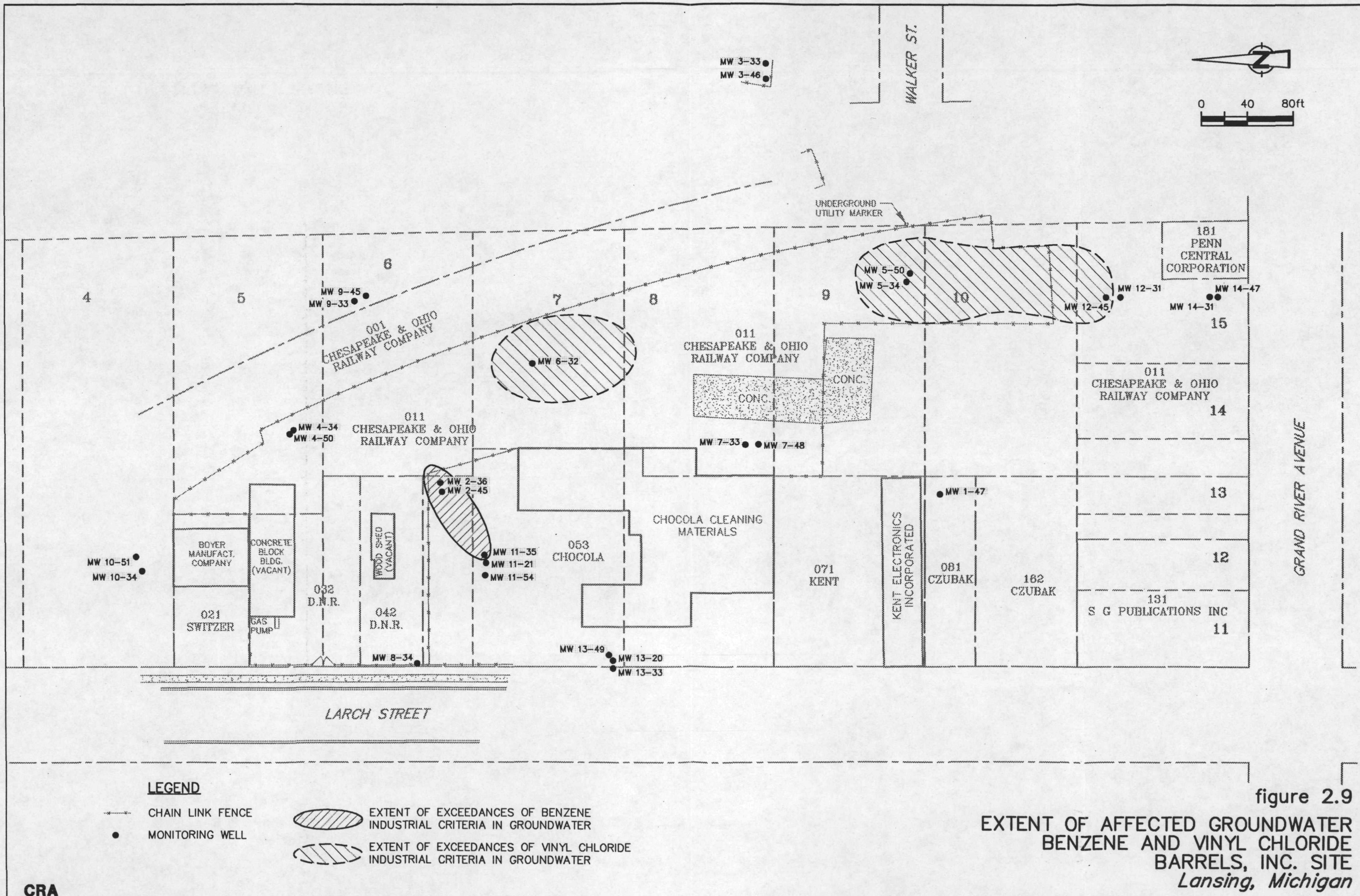



figure 2.9

EXTENT OF AFFECTED GROUNDWATER
BENZENE AND VINYL CHLORIDE
BARRELS, INC. SITE
*Lansing, Michigan*

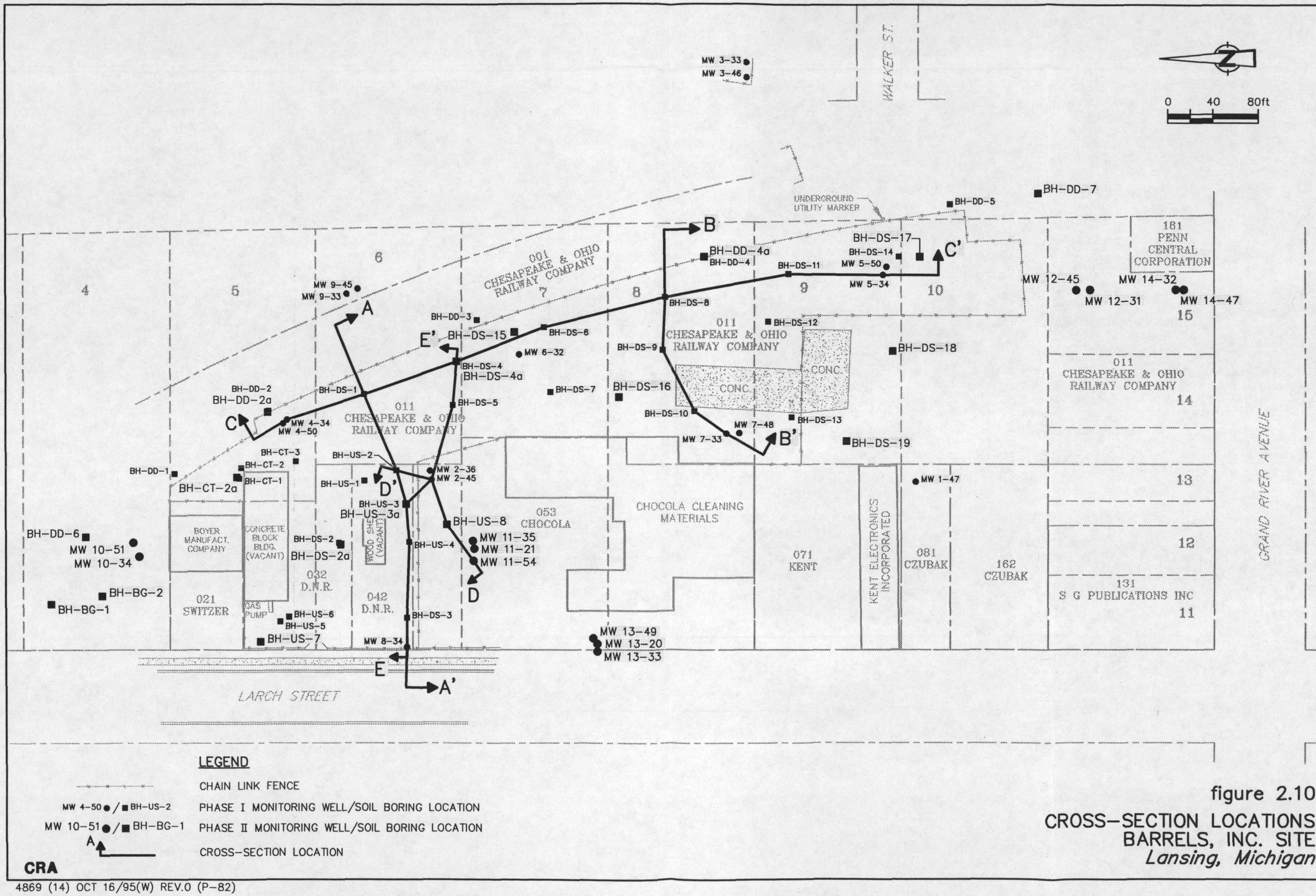



figure 2.10

CROSS-SECTION LOCATIONS
BARRELS, INC. SITE
*Lansing, Michigan*

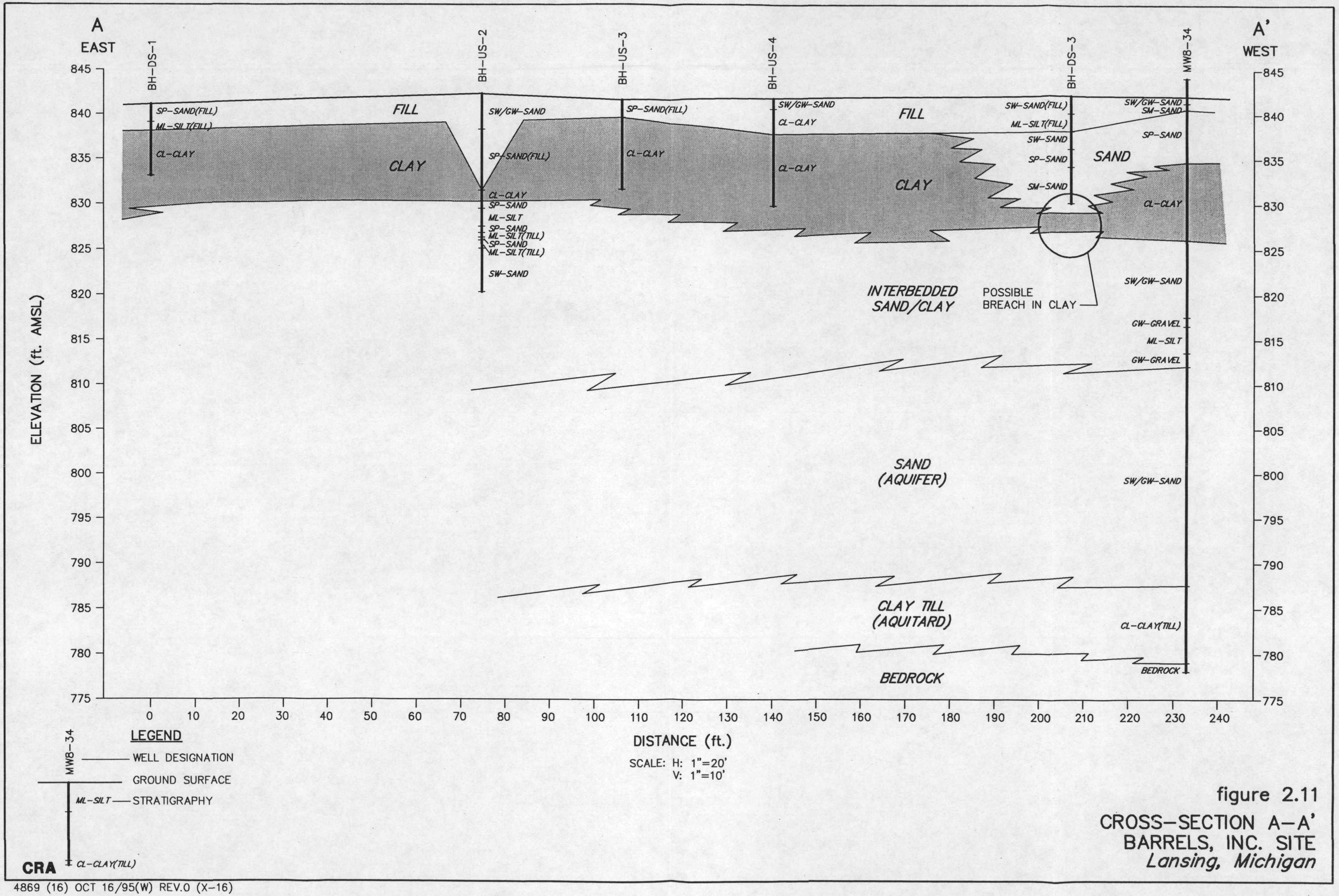



figure 2.11

CROSS-SECTION A–A'
BARRELS, INC. SITE
*Lansing, Michigan*

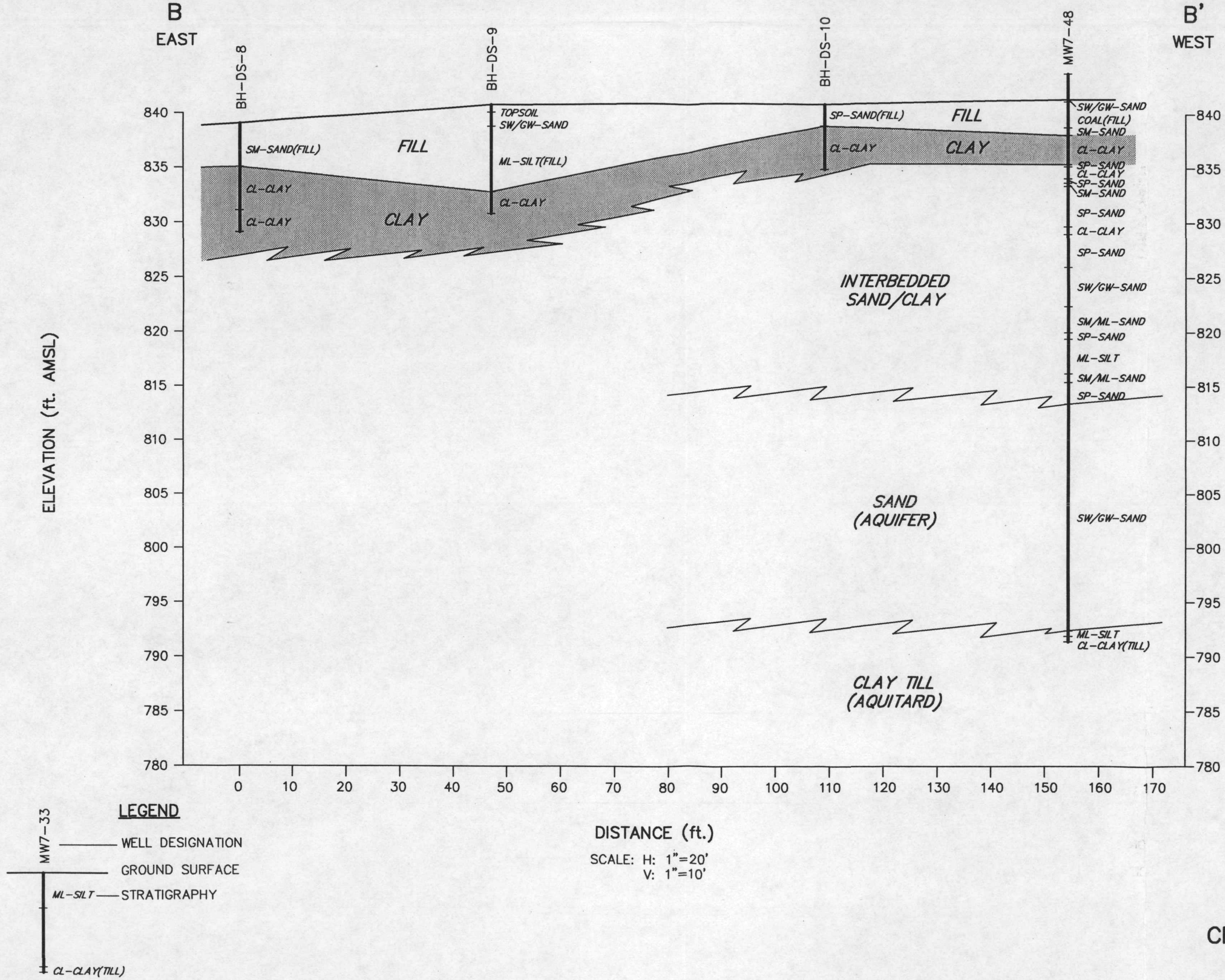



figure 2.12

CROSS-SECTION B-B'
BARRELS, INC. SITE
*Lansing, Michigan*

CRA

4869 (16) OCT 16/95(W) REV.0 (X-17)

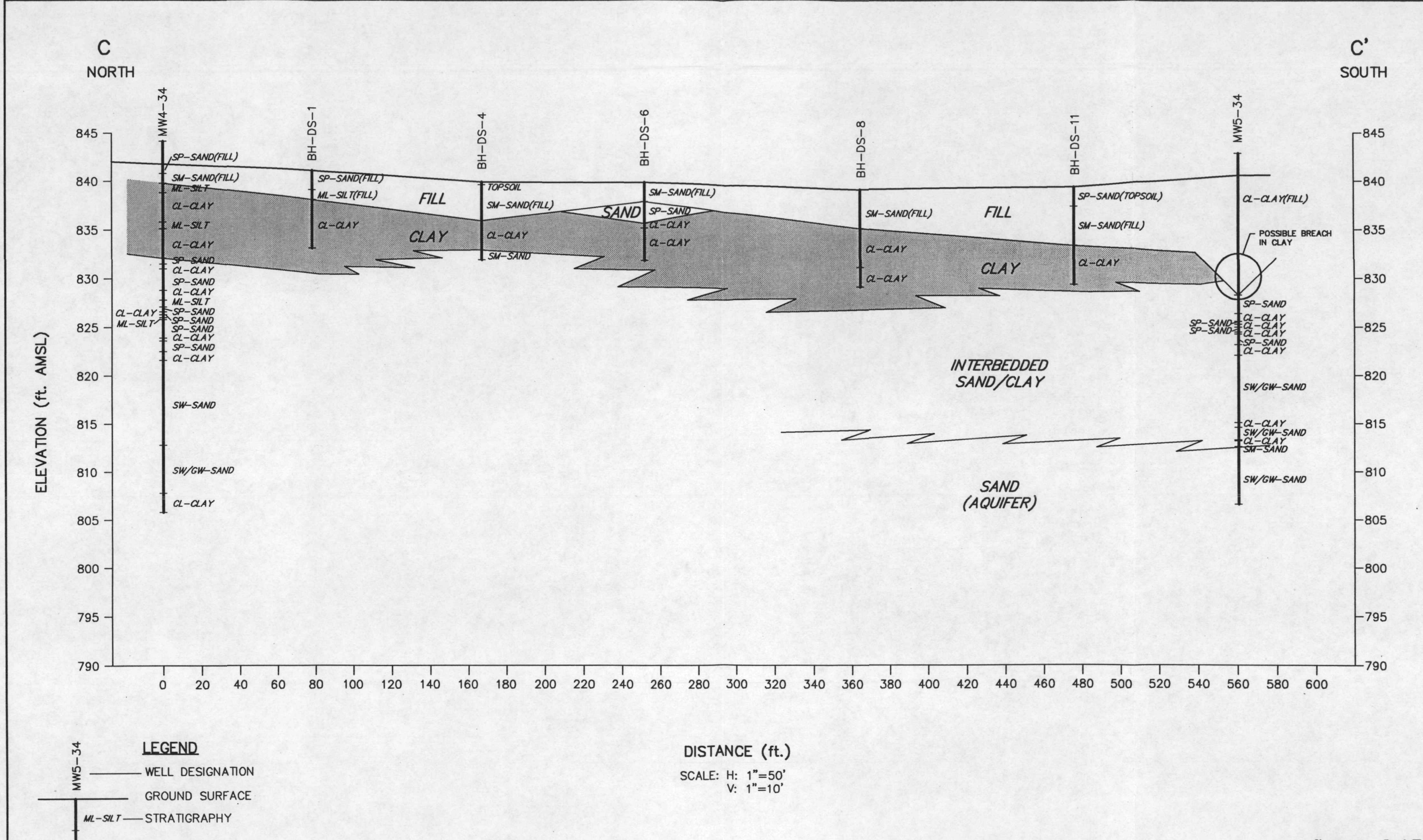



figure 2.13

CROSS-SECTION C-C'
BARRELS, INC. SITE
*Lansing, Michigan*

CRA
4869 (16) OCT 16/95(W) REV.0 (X-18)

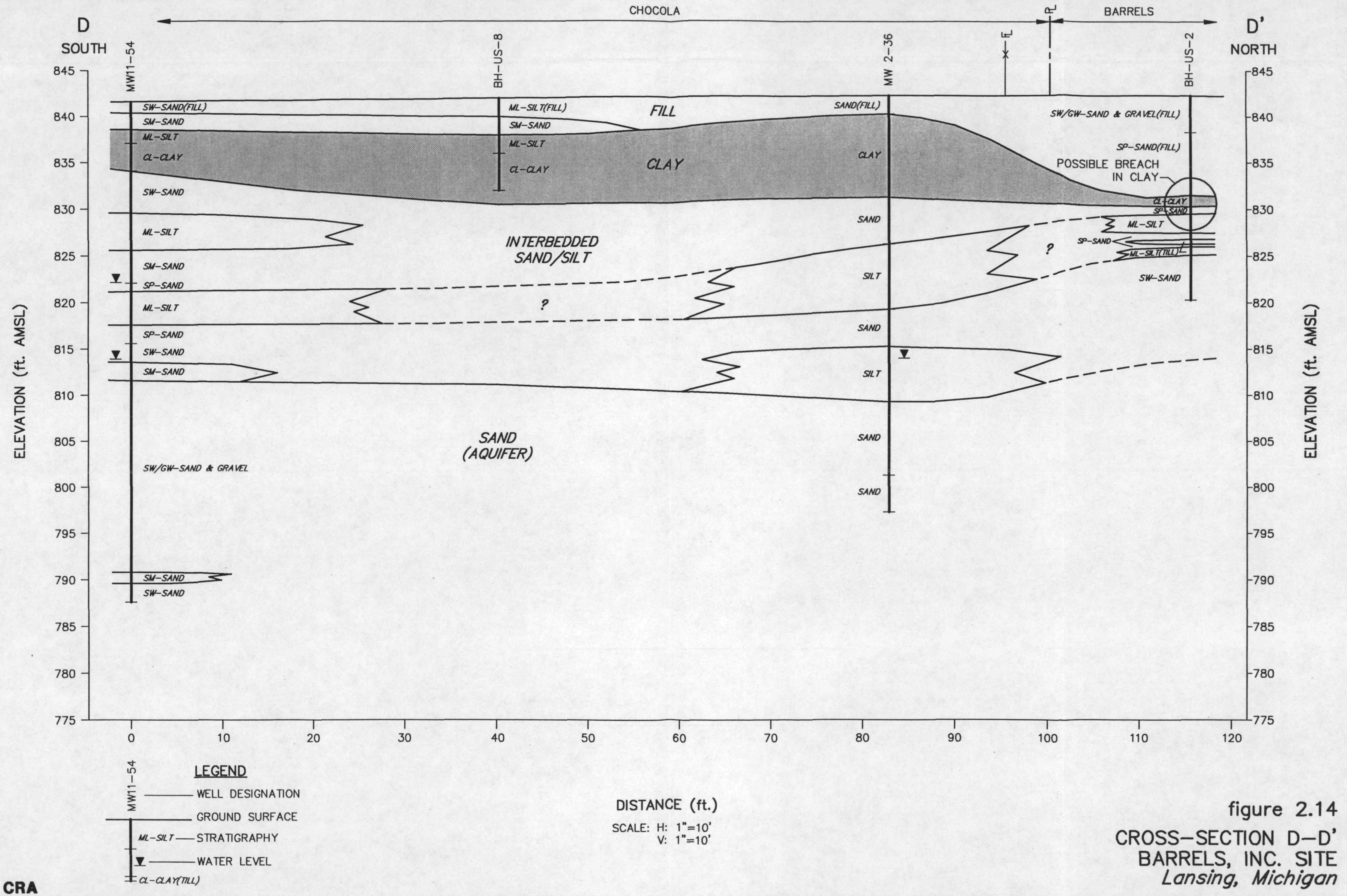



figure 2.14

CROSS-SECTION D–D'
BARRELS, INC. SITE
*Lansing, Michigan*

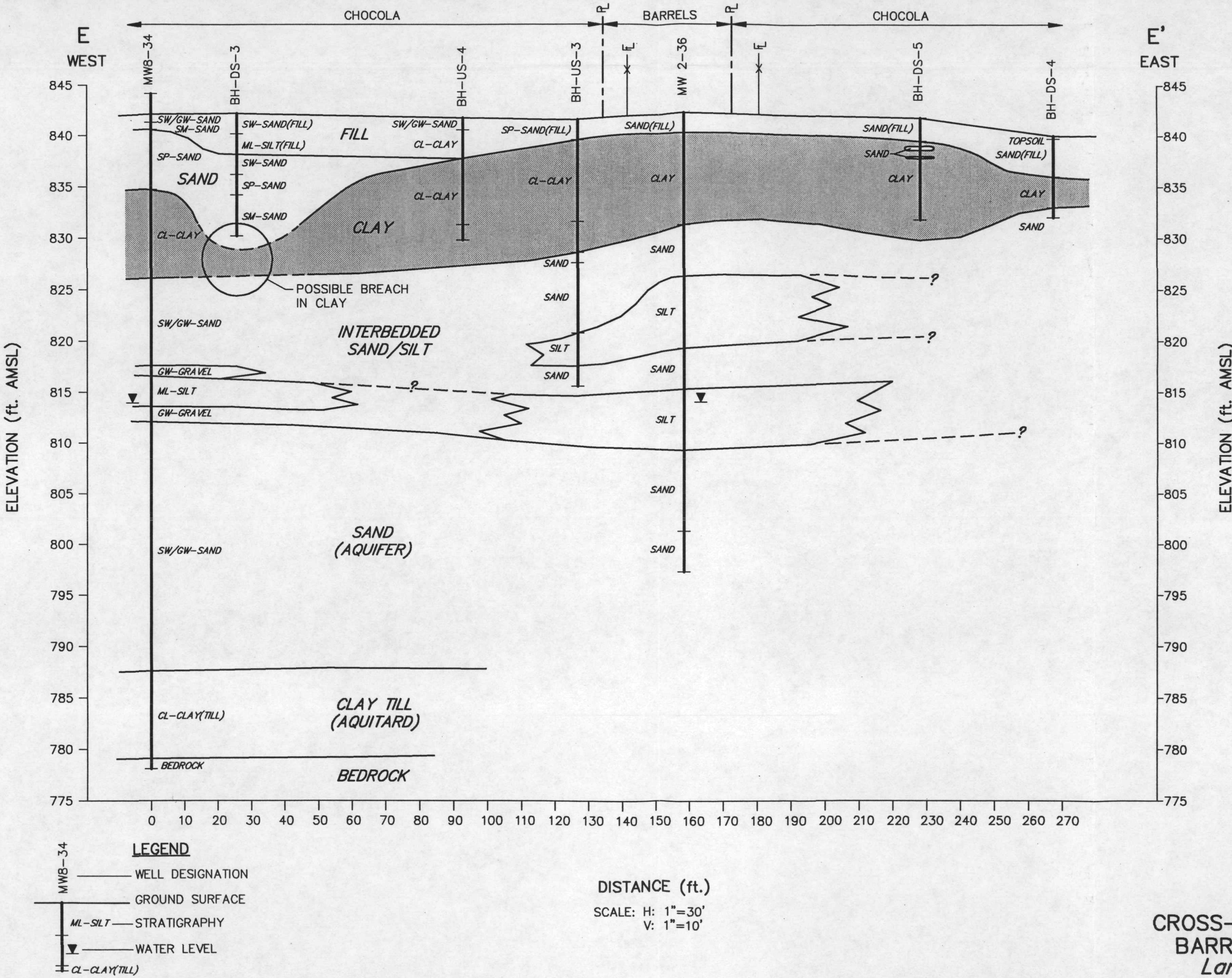



figure 2.15

CROSS-SECTION E-E'
BARRELS, INC. SITE
*Lansing, Michigan*

# TABLES

TABLE 3.1

POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
BARRELS, INC. SITE
LANSING, MICHIGAN

| | *Law or Regulation* | *Reference* | *Ambient or Chemical Specific ARAR* | *Performance, Design or Action Specific ARAR* | *Location Specific ARAR* | *Comments* |
|---|---|---|---|---|---|---|
| FEDERAL | | | | | | |
| 1. | CERCLA/SARA | 42 USC 9601 et. seq. | Applicable, relevant and appropriate requirements under Section 121 of SARA | Applicable, relevant and appropriate requirements of 40 CFR 300.68 (NCP) | N/A | Forms the basis for the comprehensive evaluation of ARARs |
| 2. | RCRA Subtitle D | 40 CFR 257 | N/A | Set standards for land disposal facilities for non-hazardous waste | N/A | Administered by MDNR under Act 641 |
| 3. | RCRA Subtitle C | 40 CFR 260-267 | N/A | Regulates the generation, transport, storage, treatment and disposal of hazardous wastes generated in the course of remedial action.<br>Regulates the construction, design, monitoring, operation and closure of hazardous waste facilities | N/A | Administered by MDNR under Act 64 |
| 4. | RCRA Land Disposal Restrictions (LDRs) | 40 CFR 268 | N/A | Prohibits land disposal for PCB soils greater than 50 ppm in RCRA Subtitle C landfill facilities | N/A | Applicable in some circumstances if remedial action involved unearthing, treating and redisposing of hazardous waste |
| 5. | Toxic Substances Control Act (TSCA) | 40 CFR 761 | N/A | Applicable to transport and disposal of PCB wastes greater than 50 ppm | N/A | Applicable to PCBs at Site if unearthed and redisposed at a permitted off-Site TSCA facility |
| 6. | Clean Air Act | 40 CFR 50 and 52 | Establishes Ambient Air Quality Standards | Implements and sets rules for a regional air pollution control program. Applicable to air emissions from any on-site treatment alternatives | N/A | Administered by MDNR under Act 348 |
| 7. | Safe Drinking Water Act | | Regulates drinking water quality using MCLs and MCLGs | Applicable to groundwater MCLs and water which may be consumed after any treatment alternative | N/A | Groundwater is not an off-Site concern |

TABLE 3.1

POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
BARRELS, INC. SITE
LANSING, MICHIGAN

| | *Law or Regulation* | *Reference* | *Ambient or Chemical Specific ARAR* | *Performance, Design or Action Specific ARAR* | *Location Specific ARAR* | *Comments* |
|---|---|---|---|---|---|---|
| 8. | Worker Safety and Health Protection | Occupational Safety and Health Administration (OSHA) | N/A | Worker safety during remedial construction | N/A | Always applicable |
| 9. | Hazardous Materials Regulations | 49 CFR 170 to 179 | N/A | Applicable to transportation of hazardous materials | N/A | Applicable if remedial action includes off-Site transport |
| 10. | Regulations for Hazardours Waste Generators and Transporters | 40 CFR 262 and 263 | N/A | Establishes responsibilities for transporters of hazardous waste in handling, transportation and management of the waste. Sets requirements for manifesting, recordkeeping, and emergency response action in case of spill | N/A | Applicable if remedial action includes off-Site transport |
| 11. | POTW Discharge | 40 CFR 403 | N/A | Establishes pretreatment standards for controlling pollutants discharge to publicly-owned treatment works (POTWs) | N/A | Not required for Site |
| 12. | Executive Order 12372 | 40 CFR 29 | N/A | Requires state and local coordination and review of proposed EPA-assisted projects | N/A | Applicable to all Sites |
| 13. | EPA National Primary Drinking Water Regulations | 40 CFR 142 | Regulates drinking water quality, using MCLs and MCLGs | N/A | N/A | Groundwater not impacted. No potable well present |
| 14. | Clean Water Act | 40 CFR 125 | Establishes acceptable surface water quality standards. | Establishes monitoring requirements and rules for water quality. | N/A | Applicable to discharges to surface water |

TABLE 3.1

POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
BARRELS, INC. SITE
LANSING, MICHIGAN

| Law or Regulation | Reference | Ambient or Chemical Specific ARAR | Performance, Design or Action Specific ARAR | Location Specific ARAR | Comments |
|---|---|---|---|---|---|
| **STATE OF MICHIGAN** | | | | | |
| 1. Natural Resources and Environmental Protection Act and Rules | Michigan Public Act 451, Part 201 | Establish acceptable cleanup levels for soil, groundwater, surface water and air | Provides for the identification, risk assessment and priority evaluation of environmental contamination sites in the State | N/A | Applicable parts to all environmental contamination sites |
| 2. Solid Waste Management Act and Regulations | Michigan Public Act 451, Part 115 | N/A | Regulates the disposal of non-hazardous solid waste | N/A | Applicable to non-hazardous materials generated at the Site |
| 3. Hazardous Waste Management Act and Rules | Michigan Public Act 451, Part 111 | N/A | Regulates the generation, transport, treatment, storage and disposal of hazardous waste | N/A | Applicable to hazardous residuals to Site |
| 4. Water Resources Commission Act | Michigan Public Act 451, Part 31 | Establishes surface water quality standards to protect public health and welfare, to enhance and maintain the quality of water, to protect State's natural resources | Establishes rules for groundwater quality.<br>Requires hydrogeologic studies before allowing a discharge into groundwater and establishes monitoring requirements | N/A | Applicable to discharges to surface water |
| 5. Liquid Industrial Waste Disposal Act | Michigan Public Act 451, Part 121 | N/A | Requires the use of a licensed liquid industrial waste hauler to transport any liquid waste off site | N/A | Applicable to off-Site transport of liquid waste |
| 6. Safe Drinking Water Act | Michigan Public Act 451, Part 87 | Establishes MCLs for specific contaminants in addition to or different from federal MCLs to protect drinking water quality | N/A | N/A | Groundwater not impacted at the Site |
| 7. Air Pollution Act | Michigan Public Act 451, Part 55 | N/A | Controls the emission of airborne contaminants to protect human health or safety, animal life, plant life of significant economic value, or property or reasonable interference with the confortable enjoyment of life or property | N/A | Applicable to any air emissions that may result due to waste disturbance or treatment |

TABLE 3.1

**POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)**
**BARRELS, INC. SITE**
**LANSING, MICHIGAN**

| | *Law or Regulation* | *Reference* | *Ambient or Chemical Specific ARAR* | *Performance, Design or Action Specific ARAR* | *Location Specific ARAR* | *Comments* |
|---|---|---|---|---|---|---|
| 8. | The Mineral Well Act (Sections 17 & 21) | Michigan Public Act 451, Part 625 | N/A | Regulates the installation of monitoring wells | N/A | Applicable to alternatives involving groundwater monitoring |
| 9. | Michigan Occupational Health and Safety Act (MIOSHA) (Parts 1-49) | Michigan Public Act 154 | N/A | Worker safety during remedial construction | N/A | Applicable to on-Site activities |
| 10. | Michigan Vehicle Code (Section 257.722) | | N/A | Governs maximum axle loading on highways | N/A | Applicable to all alternatives involving movement of equipment or materials over Michigan highways |
| 11. | Public Health Code (Part 127) | Michigan Public Act 368 | N/A | Regulates installation of extraction wells | N/A | Applicable to alternatives involving groundwater extraction |
| 12. | The Waterworks and Sewerage Systems Act | Michigan Public Act 451, Part 43 | N/A | Regulates discharges to sewers or POTWs | N/A | Applicable to alternatives involving discharges to sewers or POTWs |

Notes:

(1) N/A - Not applicable

## TABLE 4.1

## POTENTIALLY APPLICABLE TECHNOLOGIES
## BARRELS, INC. SITE
## LANSING, MICHIGAN

| *Applicable Remedy Type* | *Remedial Technology/Process Option* |
|---|---|
| Physical Containment | • Berms and Ditches<br>• Covering |
| In Situ Treatment | • Biological<br>• Soil Vapor Extraction<br>• Soil Flushing/Solvent Washing<br>• Vitrification<br>• Stabilization/Solidification |
| Removal | • Excavation |
| Ex Situ Treatment | • Bioremediation<br>• Incineration<br>• Low Temperature Thermal Desorption<br>• Advanced Electric Reactor<br>• Stabilization/Solidification<br>• Solvent Extraction<br>• Gas-Phase Chemical Reduction<br>• Groundwater Pump and Treat |
| Disposal | • On Site<br>• Off Site |
| Groundwater | • Management<br>• Pump and Treat |

TABLE 4.2

**PRESCREENING OF POTENTIAL REMEDIAL RESPONSE ACTIONS AND TECHNOLOGIES**
**BARRELS INC. SITE**
**LANSING, MICHIGAN**

| Remedy Type | REMEDY COMPONENTS | REMEDY TYPE | SHORT-TERM EFFECTIVENESS | LONG-TERM EFFECTIVENESS | REDUCTION IN MOBILITY, TOXICITY AND VOLUME | TECHNICAL FEASIBILITY | ADMINISTRATIVE FEASIBILITY | OVERALL COST | OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|
| **PHYSICAL CONTAINMENT** | | | | | | | | | |
| *Berms and Ditches* | - monitoring program<br>- institutional controls<br>- stormwater management<br>- grading and fill | Industrial | yes | no | - reduction in surficial mobility only | yes | yes | low | low |
| *Soil Cover* | - monitoring program<br>- institutional controls<br>- stormwater management<br>- grading and fill<br>- cover and sod | Industrial | yes | yes | - reduction in mobility only | yes | yes | medium | high |
| *Asphalt Cover* | - monitoring program<br>- institutional controls<br>- stormwater management<br>- grading and fill<br>- cover | Industrial | yes | yes | - reduction in mobility only | yes | yes | medium | high |
| **ON-SITE TREATMENT** | | | | | | | | | |
| **PCBs ONLY**<br>Soil Clean-up to Generic Industrial Criteria and On-Site Treatment | - soil excavation<br>- treatment by stabilization and/or incineration<br>- Site restoration 660 cu.yds | Industrial | yes | yes | yes<br>- reduction in mobility and toxicity<br>- partial reductions in volume | yes | yes | medium to high | low on its own |
| **PCBs ONLY**<br>Soil Clean-up to Generic Residential Criteria and On-Site Treatment | - soil excavation<br>- treatment by stabilization and/or incineration<br>- Site restoration 1,900 cu.yds | Residential | yes | yes | yes<br>- reduction in mobility and toxicity<br>- partial reductions in volume | yes | yes | medium to high | low on its own |
| **All Compounds**<br>Soil Clean-up to Generic Industrial Criteria and On-Site Treatment | - soil excavation<br>- treatment by vapour extraction, biological reactor, thermal destruction and/or solidification<br>- Site restoration 940 cu.yds | Industrial | yes | yes | yes<br>- reduction in mobility, toxicity and volume is parameter and treatment dependent | yes | yes | medium to very high | high |
| **All Compounds**<br>Soil Clean-up to Generic Residential Criteria and On-Site Treatment | - soil excavation<br>- treatment by vapour extraction, biological reactor, thermal destruction and/or solidification<br>- Site restoration 20,000 cu.yds | Residential | yes | yes | yes<br>- reduction in mobility, toxicity and volume is parameter and treatment dependent | yes | yes | very high | high |

**PRESCREENING OF POTENTIAL REMEDIAL RESPONSE ACTIONS AND TECHNOLOGIES**
**BARRELS INC. SITE**
**LANSING, MICHIGAN**

| Remedy Type | REMEDY COMPONENTS | REMEDY TYPE | SHORT-TERM EFFECTIVENESS | LONG-TERM EFFECTIVENESS | REDUCTION IN MOBILITY, TOXICITY AND VOLUME | TECHNICAL FEASIBILITY | ADMINISTRATIVE FEASIBILITY | OVERALL COST | OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|
| **OFF-SITE DISPOSAL** | | | | | | | | | |
| **PCBs ONLY** Soil Removal to Generic Industrial Criteria and Off-Site Disposal | - soil excavation<br>- off-site disposal<br>- Site restoration<br>660 cu.yds | Industrial | yes | yes | yes<br>- reduction in mobility, toxicity and volume | yes<br>- easy to implement utilizing standard environmental excavation and safety technology | yes | low | low on its own |
| **PCBs ONLY** Soil Removal to Generic Residential Criteria and Off-Site Disposal | - soil excavation<br>- off-site disposal<br>- Site restoration<br>1,900 cu. yds | Residential | yes | yes | yes<br>- reduction in mobility, toxicity and volume | yes<br>- easy to implement utilizing standard environmental excavation and safety technology | yes | low | low on its own |
| **All Compounds** Soil Removal to Generic Industrial Criteria and Off-Site Disposal | - soil excavation<br>- off-site disposal<br>- Site restoration<br>940 cu. yds | Industrial | yes | yes | yes<br>- reduction in mobility, toxicity and volume | yes<br>- easy to implement utilizing standard environmental excavation and safety technology | yes | medium | high |
| **All Compounds** Soil Removal to Generic Residential Criteria and Off-Site Disposal | - soil excavation<br>- off-site disposal<br>- Site restoration<br>20,000 cu. yds | Residential | yes | yes | yes<br>- reduction in mobility, toxicity and volume | yes<br>- easy to implement utilizing standard environmental excavation and safety technology | yes | very high | high |
| **OFF-SITE TREATMENT AND DISPOSAL** | | | | | | | | | |
| **PCBs ONLY** Soil Removal to Generic Industrial Criteria and Off-Site Treatment prior to disposal | - soil excavation<br>- treatment by incineration<br>- Site restoration<br>660 cu. yds | Industrial | yes | yes | yes<br>- reduction in mobility, toxicity and volume | yes | yes | high | low on its own |
| **PCBs ONLY** Soil Removal to Generic Residential Criteria and Off-Site Treatment prior to disposal | - soil excavation<br>- treatment by incineration<br>- Site restoration<br>1,900 cu. yds | Residential | yes | yes | yes<br>- reduction in mobility, toxicity and volume | yes | yes | high | low on its own |
| **All Compounds** Soil Removal to Generic Industrial Criteria and Off-Site Treatment prior to disposal | - soil excavation<br>- treatment by stabilization<br>- Site restoration<br>940 cu. yds | Industrial | yes | yes | yes<br>- reduction in mobility, toxicity and volume | yes | yes | medium | high |
| **All Compounds** Soil Removal to Generic Residential Criteria and Off-Site Treatment prior to disposal | - soil excavation<br>- treatment by stabilization<br>- Site restoration<br>20,000 cu. yds | Residential | yes | yes | yes<br>- reduction in mobility, toxicity and volume | yes | yes | very high | high |
| **GROUNDWATER** | | | | | | | | | |
| **Groundwater Management System** | - monitoring program<br>- Institutional controls<br>- contingency plan | Industrial | yes | yes | - control of mobility | yes | yes | low | high |
| **Groundwater Pump and Treat** | - monitoring program<br>- institutional controls<br>- installation of extraction wells<br>- can be used in conjunction with any other alternative(s) | Residential or Industrial | yes | no | yes<br>- reduction in mobility, and volume, not in toxicity below site | yes<br>- long-term treatment | yes | very high | high |

**TABLE 6.1**

**DETAILED COST ESTIMATE**
**ALTERNATIVE 2 - LIMITED ACTION**
**BARRELS, INC.**
**LANSING, MICHIGAN**

| *Item* | *Quantity* | *Unit* | *Unit Cost* | *Cost* |
|---|---|---|---|---|
| **CAPITAL COSTS** | | | | |
| 1) Deed Restrictions (1) | - | L.S. | - | $50,000 |
| 2) Mob/ Demob/ Decon | - | L.S. | - | $5,000 |
| 3) PCB Removal (2) | | | | |
| - Excavation (3) | 40 | cu. yds | $8.50 | $340 |
| - Transportation (4) | 40 | cu. yds | $16 | $640 |
| - Treatment/disposal | 40 | cu. yds | $180 | $7,200 |
| - Backfill | 40 | cu. yds | $12 | $480 |
| - Verification sampling (5) | 5 | each | $500 | $2,500 |
| 4) Cleaning of Tanks and Disposal of Waste Residuals | - | L.S. | - | $1,000 |
| Subtotal | | | | $67,160 |
| Bonds and Insurance (5% of subtotal) | | | | $3,358 |
| Contingency (15% of subtotal) | | | | $10,074 |
| **Total Capital Cost** | | | | $80,592 |
| **ANNUAL OPERATION AND MAINTENANCE COSTS** | | | | |
| 1) Institutional Controls (6) | | L.S. | | $5,500 |
| 2) Site Inspection (7) | 2 | rounds | $1,150 | $2,300 |
| 3) Groundwater Management System (8) | 1 | rounds | $20,000 | $20,000 |
| Subtotal | | | | $27,800 |
| Contingency (20%) | | | | $5,560 |
| Total O&M Costs | | | | $33,360 |
| **Total O&M Present Worth (30 years at 5%)** | | | | $512,827 |

TABLE 6.1

DETAILED COST ESTIMATE
ALTERNATIVE 2 - LIMITED ACTION
BARRELS, INC.
LANSING, MICHIGAN

| *Item* | *Quantity* | *Unit* | *Unit Cost* | *Cost* |
|---|---|---|---|---|
| <u>ENGINEERING COSTS</u> | | | | |
| Preparation of Contingency Plan | | | | $50,000 |
| Subtotal | | | | $50,000 |
| Congency | | | | $10,000 |
| **Total Engineering Cost** | | | | $60,000 |
| | | | | **$653,419** |
| **TOTAL PRESENT WORTH - ALTERNATIVE 2** | | | | |

Notes:

(1) Required to insure future uses of site are conducted with adequate knowledge
(2) Removal of PCB "hot spot"
(3) Unit cost as discussed with K&D Industrial Services, Inc.
(4) Unit cost as per discussion with Waste Management Eagle Valley Landfill
(5) Number of samples per MDNR guidance document titled Verification of Soil Remediation. Analytical parameters include PCBs
(6) Includes: maintaining fencing and warning signs
(7) Includes: property and grounds inspection for signs of intruders and dangerous conditions
(8) Includes: groundwater sampling and analysis from the monitoring wells placed during the RI

# TABLE 6.2

## DETAILED COST ESTIMATE
## ALTERNATIVE 3 - ASPHALT COVER
## BARRELS, INC.
## LANSING, MICHIGAN

| *Item* | *Quantity* | *Unit* | *Unit Cost* | *Cost* |
|---|---|---|---|---|
| CAPITAL COSTS | | | | |
| 1) Deed Restrictions | - | L.S. | - | $50,000 |
| 2) Mob/ Demob/ Decon | - | L.S. | - | $25,000 |
| 3) PCB Removal | | | | |
| - Excavation | 40 | cu. yds | $8.50 | $340 |
| - Transportation | 40 | cu. yds | $16 | $640 |
| - Treatment/disposal | 40 | cu. yds | $180 | $7,200 |
| - Backfill | 40 | cu. yds | $12 | $480 |
| - Verification sampling | 5 | each | $500 | $2,500 |
| 4) Asphalt Cover | | | | |
| a) Material | | | | |
| i) preparation (1) | 2,000 | cu.yds | $5 | $10,000 |
| ii) base (2) | 2,400 | cu.yds | $7 | $16,800 |
| iii) Asphalt (3) | 14,000 | sq. yds | $4 | $56,000 |
| b) Construction | | | | |
| i) preparation (4) | 14,000 | sq. yds | $2 | $28,000 |
| ii) base | 2,400 | cu.yds | $3 | $7,200 |
| iii) asphalt | 14,000 | sq. yds | $2 | $28,000 |
| 5) Stormwater Collection (5) | - | L.S. | - | $20,000 |
| 6) Fence | - | L.S. | - | $25,000 |
| 7) Cleaning of Tanks and Disposal of Waste Residuals | - | L.S | - | $1,000 |
| Subtotal | | | | $278,160 |
| Bonds and Insurance (5% of subtotal) | | | | $13,908 |
| Contingency (15% of subtotal) | | | | $41,724 |
| **Total Capital Cost** | | | | $333,792 |

**TABLE 6.2**

**DETAILED COST ESTIMATE**
**ALTERNATIVE 3 - ASPHALT COVER**
**BARRELS, INC.**
**LANSING, MICHIGAN**

| *Item* | | *Quantity* | *Unit* | *Unit Cost* | *Cost* |
|---|---|---|---|---|---|
| ANNUAL OPERATION AND MAINTENANCE COSTS | | | | | |
| 1) | Institutional Controls | - | L.S. | - | $5,500 |
| 2) | Site Inspection | 2 | rounds | $1,150 | $2,300 |
| 3) | Groundwater Management System | 1 | rounds | $20,000 | $20,000 |
| 4) | Maintenance (6) | - | L.S | - | $3,800 |
| Subtotal | | | | | $31,600 |
| Contingency (20%) | | | | | $6,320 |
| Total O&M Costs | | | | | $37,920 |
| **Total O&M Present Worth (30 years at 5%)** | | | | | $582,925 |
| ENGINEERING COSTS | | | | | |
| 1) | Preparation of Contingency Plan | - | L.S. | - | $50,000 |
| 2) | Design | - | L.S | - | $40,000 |
| 3) | Oversight | - | L.S | - | $60,000 |
| Subtotal | | | | | $150,000 |
| Contingency (20%) | | | | | $30,000 |
| **Total Engineering Cost** | | | | | $180,000 |
| **TOTAL PRESENT WORTH - ALTERNATIVE 3** | | | | | **$1,096,717** |

Notes:

(1) Supply materials for grading subbase
(2) 6" of gravel
(3) 3" of binder mix
(4) grading of subbase
(5) Install diversion ditches and erosion control
(6) Based on $1,000 years 1-4, 6-9, 11-14, 16-19, 21-24, and 26-29; $5,000 years 5, 10, 20, 25, and 30; and $70,000 year 15

**TABLE 6.3**

**DETAILED COST ESTIMATE**
**ALTERNATIVE 4 - SOIL REMOVAL (INDUSTRIAL) AND OFF-SITE DISPOSAL**
**BARRELS, INC.**
**LANSING, MICHIGAN**

| *Item* | *Quantity* | *Unit* | *Unit Cost* | *Cost* |
|---|---|---|---|---|
| CAPITAL COSTS | | | | |
| 1) Deed Restrictions | - | L.S. | - | $50,000 |
| 2) Mob/ Demob/ Decon | - | L.S. | - | $30,000 |
| 3) PCB Removal | | | | |
| - Excavation | 40 | cu. yds | $8.50 | $340 |
| - Transportation | 40 | cu. yds | $16 | $640 |
| - Treatment/disposal | 40 | cu. yds | $180 | $7,200 |
| - Backfill | 40 | cu. yds | $12 | $480 |
| - Verification sampling | 5 | each | $500 | $2,500 |
| 4) Soil Removal | | | | |
| - Excavation | 940 | cu.yds | $8.50 | $7,990 |
| - Transportation | 940 | cu.yds | $16 | $15,040 |
| - Characterization/ verification sampling | 20 | each | $1,155 | $23,100 |
| 5) Disposal | | | | |
| - PCB | 660 | cu.yds | $180 | $118,800 |
| - Hazardous | 100 | cu.yds | $125 | $12,500 |
| - Non-hazardous | 180 | cu.yds | $30 | $5,400 |
| 6) Backfill | 940 | cu.yds | $12 | $11,280 |
| 7) Fence | - | L.S. | - | $10,000 |
| 8) Cleaning of Tanks and Disposal of Waste Residuals | - | L.S. | - | $1,000 |
| Subtotal | | | | $296,270 |
| Bonds and Insurance (5% of subtotal) | | | | $14,814 |
| Contingency (15% of subtotal) | | | | $44,441 |
| **Total Capital Costs** | | | | $355,524 |

**TABLE 6.3**

**DETAILED COST ESTIMATE**
**ALTERNATIVE 4 - SOIL REMOVAL (INDUSTRIAL) AND OFF-SITE DISPOSAL**
**BARRELS, INC.**
**LANSING, MICHIGAN**

| *Item* | *Quantity* | *Unit* | *Unit Cost* | *Cost* |
|---|---|---|---|---|
| ANNUAL OPERATION AND MAINTENANCE COSTS | | | | |
| 1) Institutional Controls | - | L.S. | - | $5,500 |
| 2) Site Inspection | 2 | rounds | $1,150 | $2,300 |
| 3) Groundwater Management System | 1 | rounds | $20,000 | $20,000 |
| Subtotal | | | | $27,800 |
| Contingency (20%) | | | | $5,560 |
| Total O&M Costs | | | | $33,360 |
| **Total O&M Present Worth (30 years at 5%)** | | | | $512,827 |
| ENGINEERING COSTS | | | | |
| 1) Preparation of Contingency Plan | | | | $50,000 |
| 2) Design | | | | $40,000 |
| 3) Oversight | | | | $60,000 |
| Subtotal | | | | $150,000 |
| Contingency (20%) | | | | $30,000 |
| **Total Engineering Cost** | | | | $180,000 |
| **TOTAL PRESENT WORTH - ALTERNATIVE 4** | | | | **$1,048,351** |